



ELECTRONICS

Approval



DATE : July. 14, 2010.

**SAMSUNG TFT-LCD**  
**MODEL NO. : LTN097XL01-A01**

NOTE : Extension code [ -A01 ]  
→ LTN097XL01-A01  
Surface type [ **Glare** ]

Any modification of Spec is not allowed without SEC's permission

APPROVED BY : \_\_\_\_\_

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**SAMSUNG ELECTRONICS CO., LTD.**

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# REVISION HISTORY

Approval

Date	Revision No.	Page	Summary
Jul.14.2010	A00	All	The Approval specification of LTN097XL01-A01 was issued first.

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## GENERAL DESCRIPTION

### DESCRIPTION

LTN097XL01-A01 is a color active matrix TFT (Thin Film Transistor) liquid crystal display (LCD) that uses amorphous silicon TFT as switching devices. This model is composed of a TFT LCD panel, a driver circuit and a backlight system. The resolution of a 9.7" contains 1024 x 768 pixels and can display up to 262,144 colors. 6 O'clock direction is the Optimum viewing angle.

### FEATURES

- High contrast ratio, high aperture structure
- 1024 x 768 pixels resolution
- LED BLU Structure
- DE (Data enable) only mode.
- 3.3V LVDS Interface
- RoHS Compliance
- PB, Halogen Free Product

### APPLICATIONS

- Notebook PC
- If the usage of this product is not for PC application, but for others, please contact SEC

## GENERAL INFORMATION

Item	Specification	Unit	Note
Display area	196.608(H) X 147.456(V) (9.7"diagonal)	mm	
Driver element	a-si TFT active matrix		
Display colors	262,144		
Number of pixel	1024 x 768(XGA)	pixel	4 : 3
Pixel arrangement	RGB vertical stripe		
Pixel pitch	0.192(H) x 0.192(V) (TYP.)	mm	
Display Mode	Normally Black, PLS mode		
Glass Thickness	0.3T		
Surface treatment	Haze 0, Hard-Coating 3H		

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## Mechanical Information

Item		Min.	Typ.	Max.	Unit	Note
Module size	Horizontal (H)	209.9	210.2	210.5	Mm	Outline with Bracket
	Vertical (V)	165.9	166.2	166.5	mm	Module ~ PCB
	Depth (D)	2.90	3.15	3.40	mm	(1)
Weight		-	151	156	g	

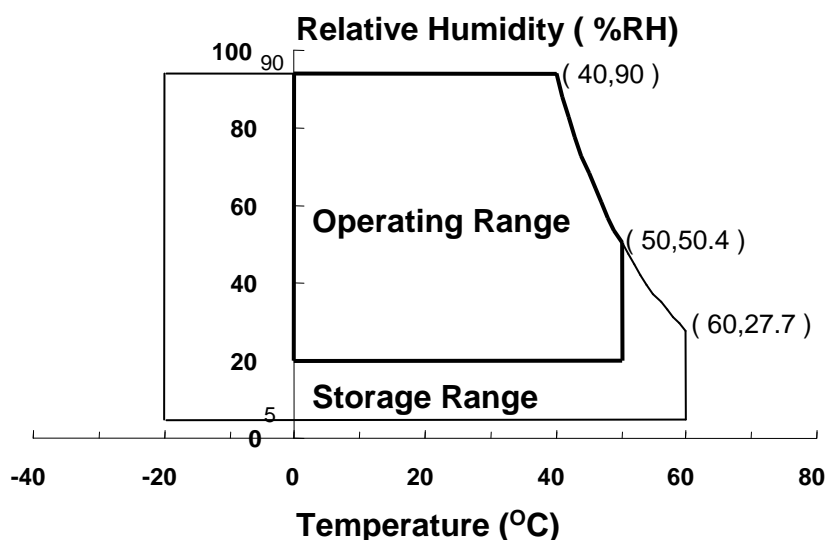
Note (1) Measurement condition of outline dimension  
 . Equipment : Vernier Calipers  
 . Push Force : 750g · f (minimum)

## 1. ABSOLUTE MAXIMUM RATINGS

### 1.1 ENVIRONMENTAL ABSOLUTE RATINGS

Item	Symbol	Min.	Max.	Unit	Note
Storage temperate	TSTG	-20	60	°C	(1)
Operating temperate (Temperature of glass surface)	TOPR	0	50	°C	(1)
Shock ( non-operating )	Snop	-	240	G	(2),(4)
Vibration (non-operating)	Vnop	-	2.41	G	(3),(4)

Note (1) Temperature and relative humidity range are shown in the figure below.  
 95 % RH Max. ( $40\text{ }^{\circ}\text{C} > T_a$ )  
 Maximum wet - bulb temperature at  $39\text{ }^{\circ}\text{C}$  or less. ( $T_a \geq 40\text{ }^{\circ}\text{C}$ ) No condensation



- (2) 2ms, half sine wave, one time for  $\pm X, \pm Y, \pm Z$ .  
 (3) 5 - 500 Hz, random vibration, 30min for X, Y, Z.  
 (4) At testing Vibration and Shock, the fixture in holding the Module to be tested have to be hard and rigid enough so that the Module would not be twisted or bent by the fixture.

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## 1.2 ELECTRICAL ABSOLUTE RATINGS

## (1) TFT LCD MODULE

 $V_{DD} = 3.3V, V_{SS} = GND = 0V$ 

Item	Symbol	Min.	Max.	Unit	Note
Power Supply Voltage	$V_{DD}$	$V_{DD} - 0.3$	$V_{DD} + 0.3$	V	(1)
Logic Input Voltage	$V_{DD}$	$V_{DD} - 0.3$	$V_{DD} + 0.3$	V	(1)
BLU Operating Voltage	$V_{BLU}$	16.8	19.2	V	(1)

Note (1) Within  $T_a$  ( $25 \pm 2$  °C )

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## 2. OPTICAL CHARACTERISTICS

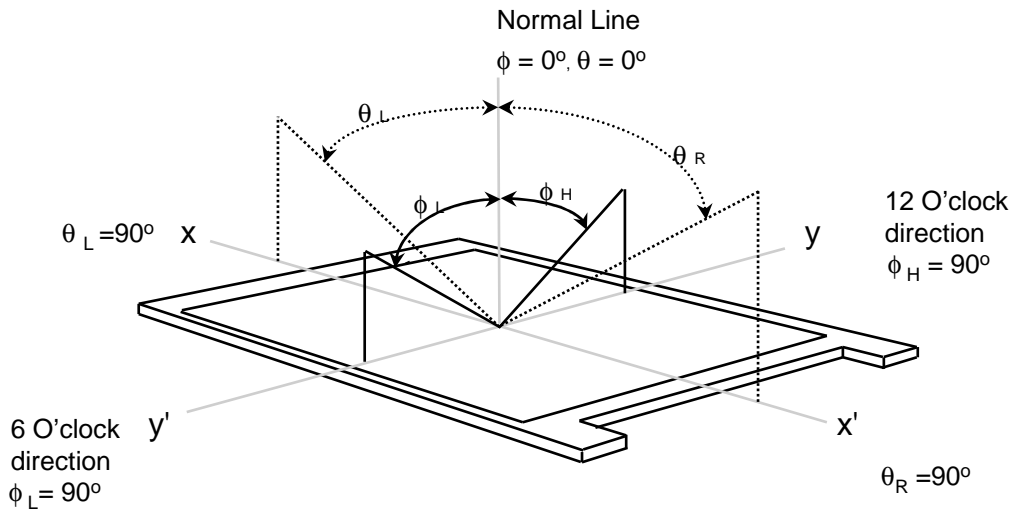
The following items are measured under stable conditions. The optical characteristics should be measured in a dark room or equivalent state with the methods shown in Note (5).  
Measuring equipment : TOPCON BM-5A and PR-650

\*  $T_a = 25 \pm 2 \text{ }^\circ\text{C}$ ,  $V_{DD}=3.3\text{V}$ ,  $f_v=60\text{Hz}$ ,  $f_{DCLK}=100\text{MHz}$ ,  $I_L = 20\text{mA}$ , 80% duty

Item	Symbol	Condition	Min.	Typ.	Max	Unit	Note	
Contrast Ratio (5 Points)	CR	Normal Viewing Angle $\phi = 0$ $\theta = 0$	700	900	-	-	(1), (2), (5)	
Response Time at $T_a$ ( Rising + Falling )	$T_{RT}$		-	30	35	Msec	(1), (3)	
Average Luminance of White (5 Points)	$Y_{L,AVE}$		350	390	-	cd/m <sup>2</sup>	(1), (4)	
Color Chromaticity ( CIE 1931)	Red		$R_x$	Typ -0.03	0.605	Typ +0.03	-	(1), (5) Measured by PR-650
			$R_y$		0.345			
	Green		$G_x$		0.325			
			$G_y$		0.570			
	Blue	$B_x$	0.150					
		$B_y$	0.125					
	White	$W_x$	0.313					
$W_y$		0.329						
Viewing Angle	Hor.	$\theta_L$	-	89	-	Degrees	(1), (5) BM-5A	
		$\theta_R$	-	89	-			
	Ver.	$\phi_H$	-	89	-			
		$\phi_L$	-	89	-			
Color Gamut	CG	-	52	-	%			
13 Points White Variation	$\delta_L$	-	-	1.54	-	(6)		

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Note 1) Definition of Viewing Angle : Viewing angle range( $10 \leq C/R$ )

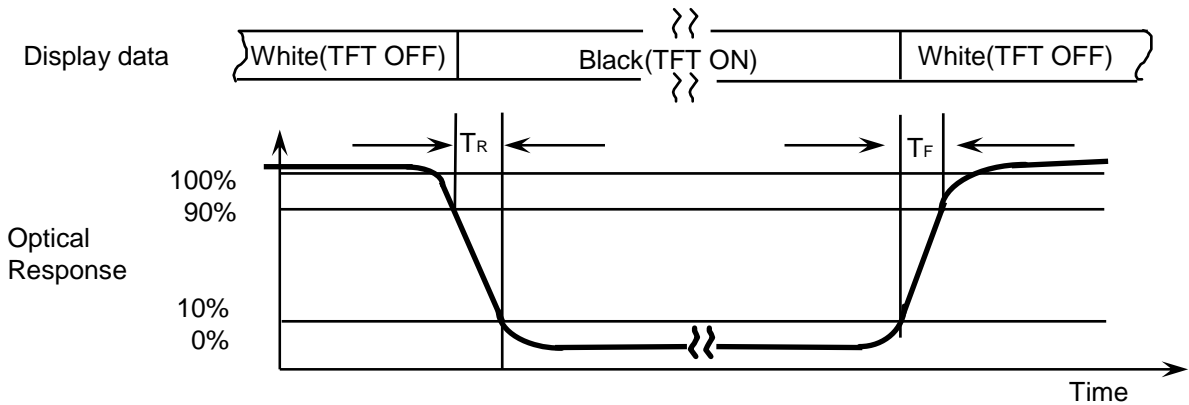


Note 2) Definition of Contrast Ratio (CR) : Ratio of gray max (Gmax) ,gray min (Gmin) at 5 points(4, 5, 7, 9, 10)

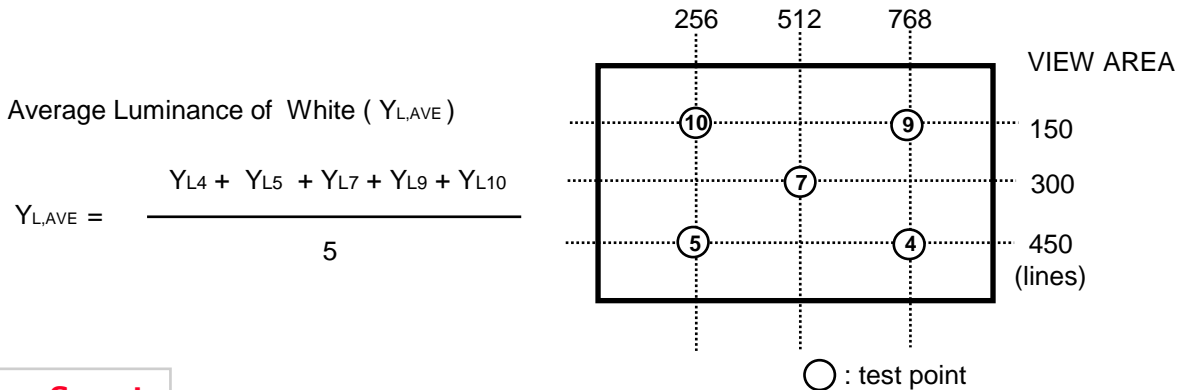
$$CR = \frac{CR(4) + CR(5) + CR(7) + CR(9) + CR(10)}{5}$$

Points : (4) , (5) , (7) , (9) , (10) at the figure of Note (6).

Note 3) Definition of Response time :



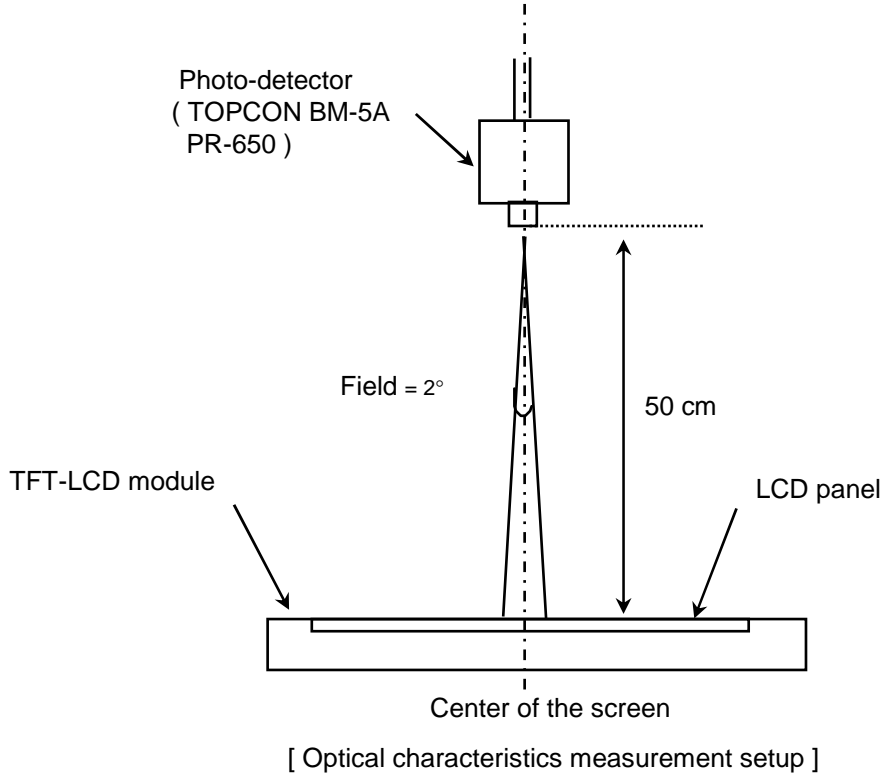
Note 4) Definition of Average Luminance of White : measure the luminance of white at 5 points.



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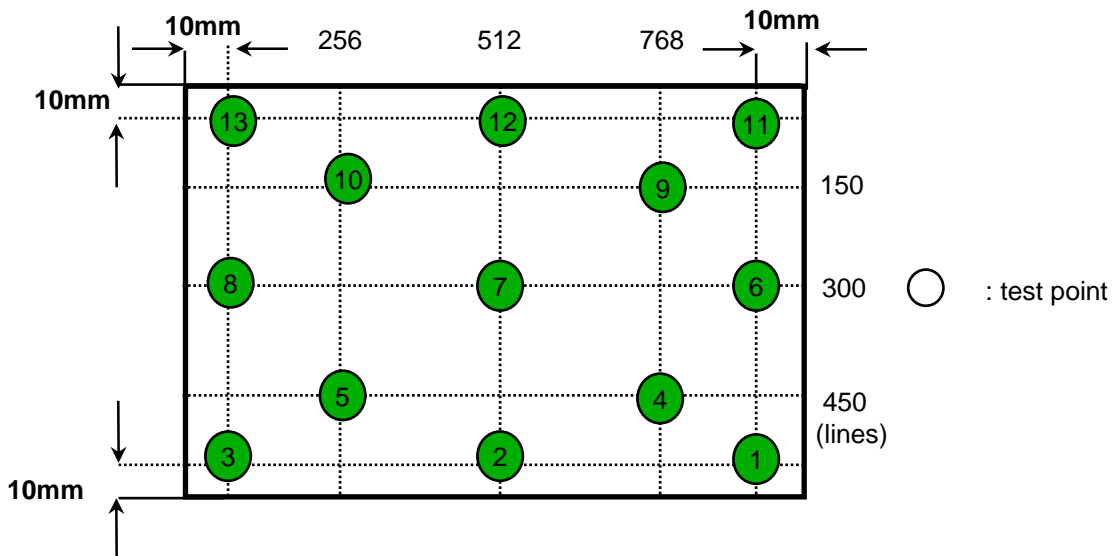


Note 5) After stabilizing and leaving the panel alone at a given temperature for 30 min , the measurement should be executed. Measurement should be executed in a stable, windless, and dark room. 30 min after lighting the backlight. This should be measured in the center of screen.  
 LED current : 20mA ( Inverter : SIC-130T )  
 Environment condition :  $T_a = 25 \pm 2 \text{ } ^\circ\text{C}$



Note 6) Definition of 13 points white variation ( $\delta L$ ), CR variation( $C_{VER}$ ) [ ① ~ ⑬ ]

$$\delta L = \frac{\text{Maximum luminance of 13 points}}{\text{Minimum luminance of 13 points}}$$



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### 3. ELECTRICAL CHARACTERISTICS

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#### 3.1 TFT LCD MODULE

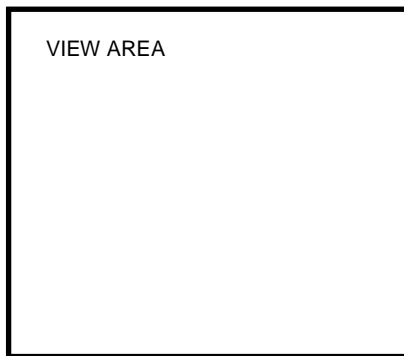
Item	Symbol	Min.	Typ.	Max.	Unit	Ta= 25±2°C Note	
Voltage of Power Supply	V <sub>DD</sub>	3.0	3.3	3.6	V		
Differential Input Voltage for LVDS Receiver Threshold	High	V <sub>IH</sub>	-	-	+100	mV	
	Low	V <sub>IL</sub>	-100	-	-	mV	
Vsync Frequency	f <sub>v</sub>	-	60	-	Hz		
Main Frequency	f <sub>DCLK</sub>	-	100	-	MHz		
Rush Current	I <sub>RUSH</sub>	-	-	1.5	A	(4)	
Current of Power Supply	White	I <sub>DD</sub>	-	297	327	mA	(2),(3)*a
	Mosaic		-	242	267	mA	(2),(3)*b
	V. stripe		-	333	366	mA	(2),(3)*c

Note (1) Display data pins and timing signal pins should be connected.( GND = 0V )

(2) f<sub>v</sub> = 60Hz, f<sub>DCLK</sub> = 100 MHz, V<sub>DD</sub> = 3.3V , DC Current.

(3) Power dissipation pattern

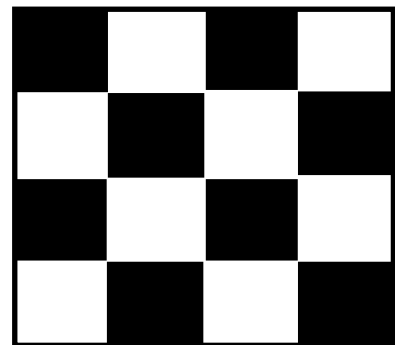
\*a) White Pattern



\*b) Mosaic Pattern

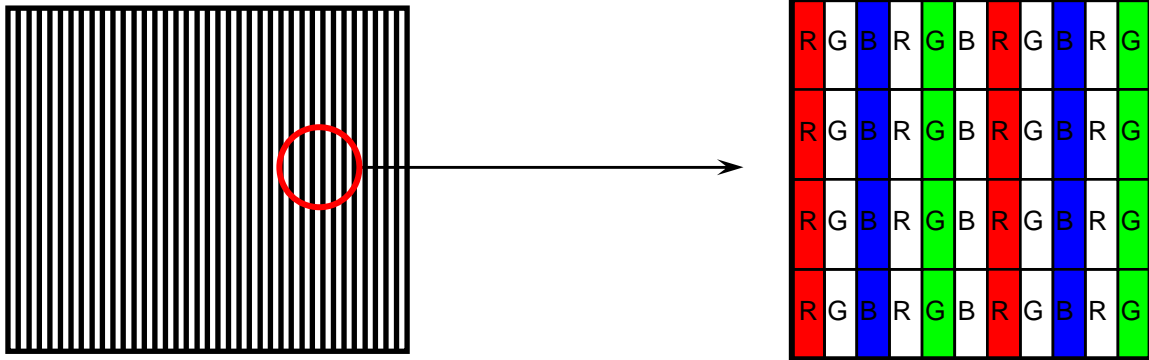
Display Brightest Gray Level →

Display Darkest Gray Level →

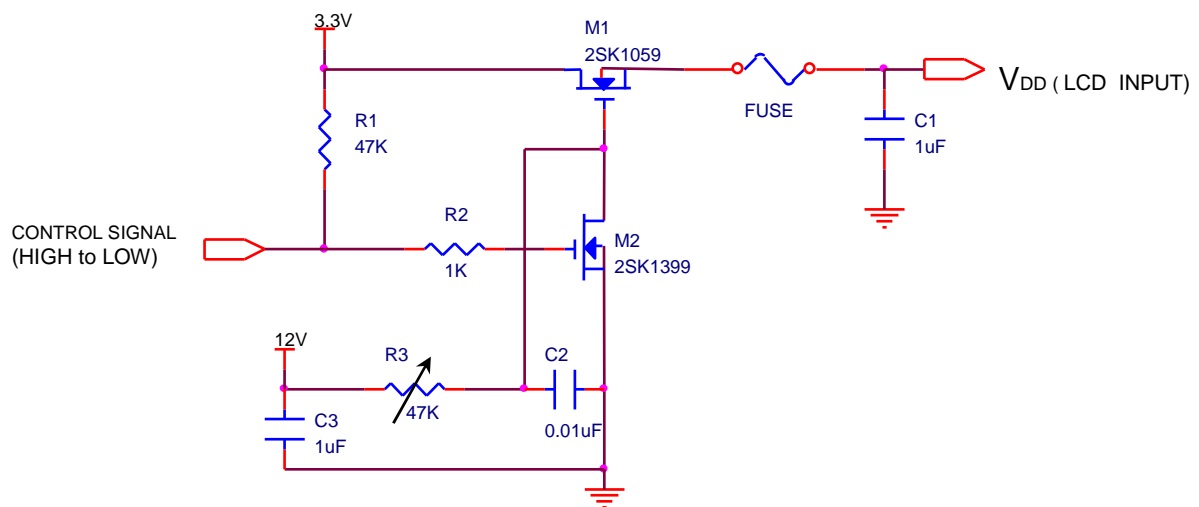


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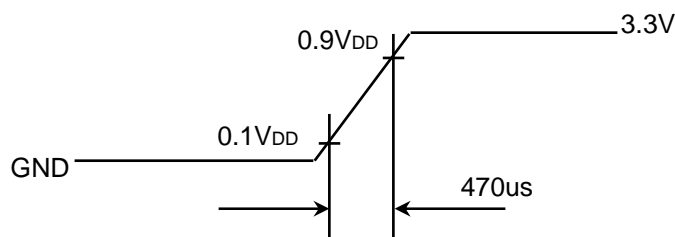
\*c) 1dot Vertical stripe pattern



4) Rush current measurement condition



$V_{DD}$  rising time is 470us



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## 3.2 BACK-LIGHT UNIT

Ta= 25 ± 2 °C

Item	Symbol	Min.	Typ.	Max.	Unit	Note
LED Forward Current	IF	-	20	-	mA	
LED Forward Voltage	VF	2.8	2.9	3.0	V	
BL power consumption	Pin	-	2.1	-	W	-
Operating Life Time	Hr	12000	-	-	Hour	(1)

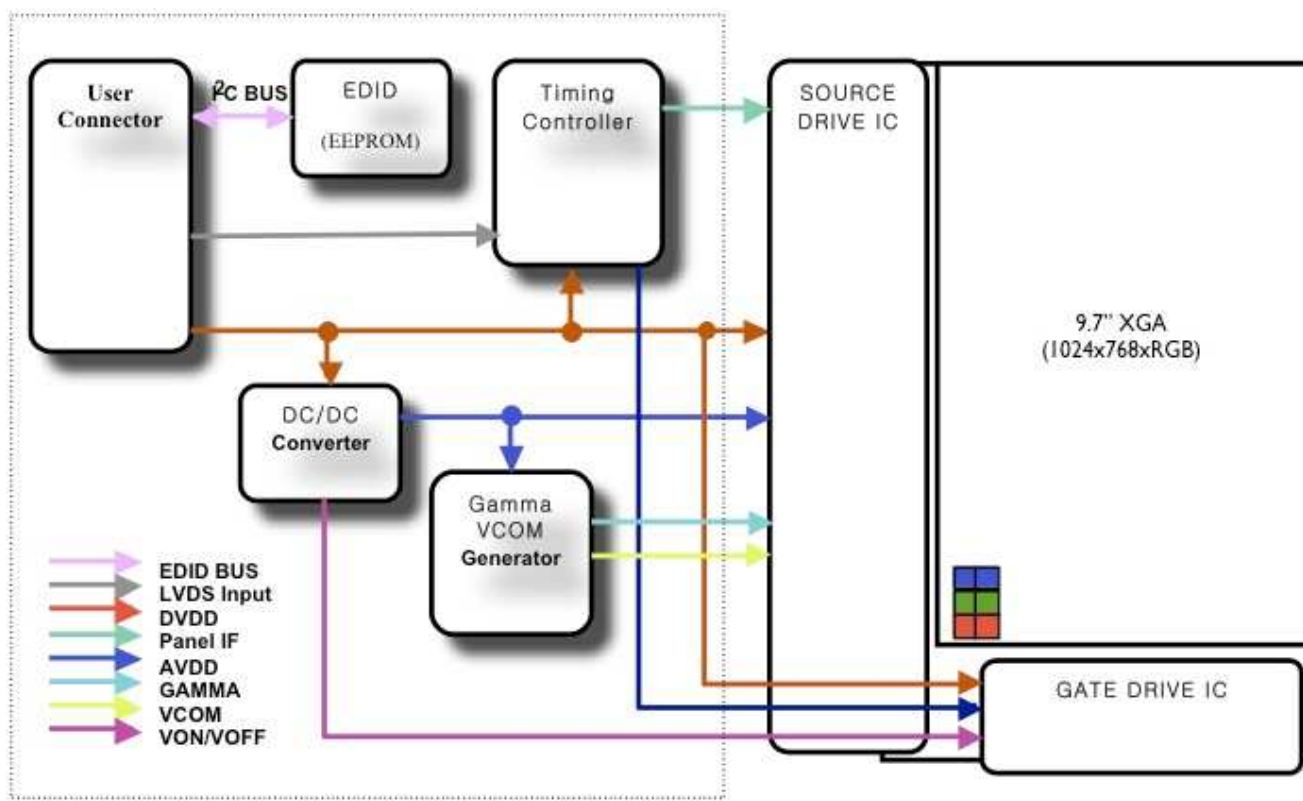
Note (1) Life time (Hr) of LEDs can be defined as the time in which it continues to operate under the condition Ta= 25 ± 2 °C and IF = 20 mA until one of the following event occurs.  
When the brightness becomes 50% or lower than the original.

Ta= 25 ± 2 °C

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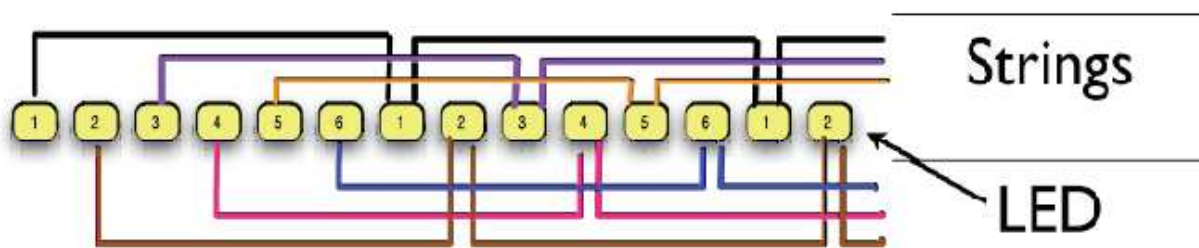
## 4. BLOCK DIAGRAM

### 4.1 TFT LCD Module



< LCD Block Diagram >

### 4.2 LED placement structure



< LED Connection on FPC >

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## 5. INPUT TERMINAL PIN ASSIGNMENT

### 5.1. Input Signal & Power (LVDS, Connector : I-PEX 20474-030E-12 or equivalent )

Pin	Symbol	Function
1	GND	Ground
2	VDD	Logic power 3.3V (Panel logic, BL logic)
3	VDD	Logic power 3.3V (Panel logic, BL logic)
4	VEDID	EDID 3.3V power
5	WPN	WPN
6	SCL	Clock for EDID
7	SDA	Data for EDID
8	0_RXIN0-	LVDS 0th Signal Negative(Odd)
9	0_RXIN0+	LVDS 0th Signal Positive(Odd)
10	GND	Ground
11	0_RXIN1-	LVDS 1st Signal Negative(Odd)
12	0_RXIN1+	LVDS 1st Signal Positive(Odd)
13	GND	Ground
14	0_RXIN2-	LVDS 2nd Signal Negative(Odd)
15	0_RXIN2+	LVDS 2nd Signal Positive(Odd)
16	GND	Ground
17	0_RXCLKIN-	LVDS Clock Signal Negative (Odd)
18	0_RXCLKIN+	LVDS Clock Signal Positive (Odd)
19	C/E_EN	Color Engine Enable pin
20	NC	Not Connected
21	Vdc	LED Anode (Positive)
22	Vdc	LED Anode (Positive)
23	NC	Not connected
24	Vdc1	LED Cathode (Negative)
25	Vdc2	LED Cathode (Negative)
26	Vdc3	LED Cathode (Negative)
27	Vdc4	LED Cathode (Negative)
28	Vdc5	LED Cathode(Negative)
29	Vdc6	LED Cathode(Negative)
30	NC	Not Connected

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## 5.2 LVDS Interface

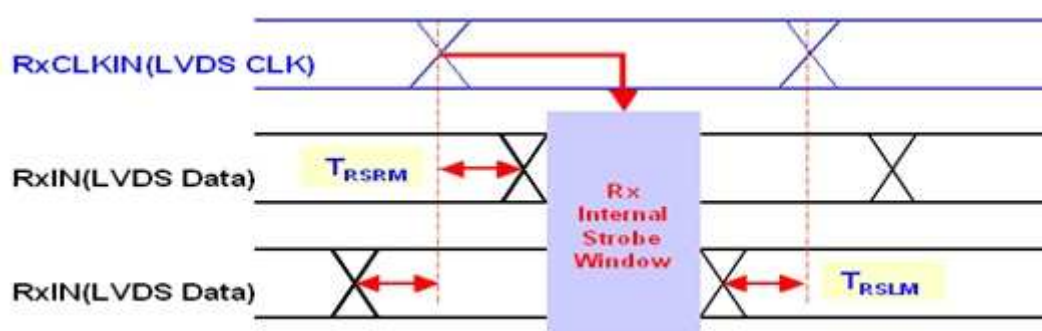
### 5.2.1 LVDS DC characteristic

ITEM	SYMBOL	MIN.	TYP.	MAX.	UNIT	NOTE
LVDS Differential Voltage	VID	100	-	200	mV	
Input Common Mode Voltage	$V_{CM}$	0.4	1.2	1.8	V	

### 5.2.2 LVDS AC characteristic

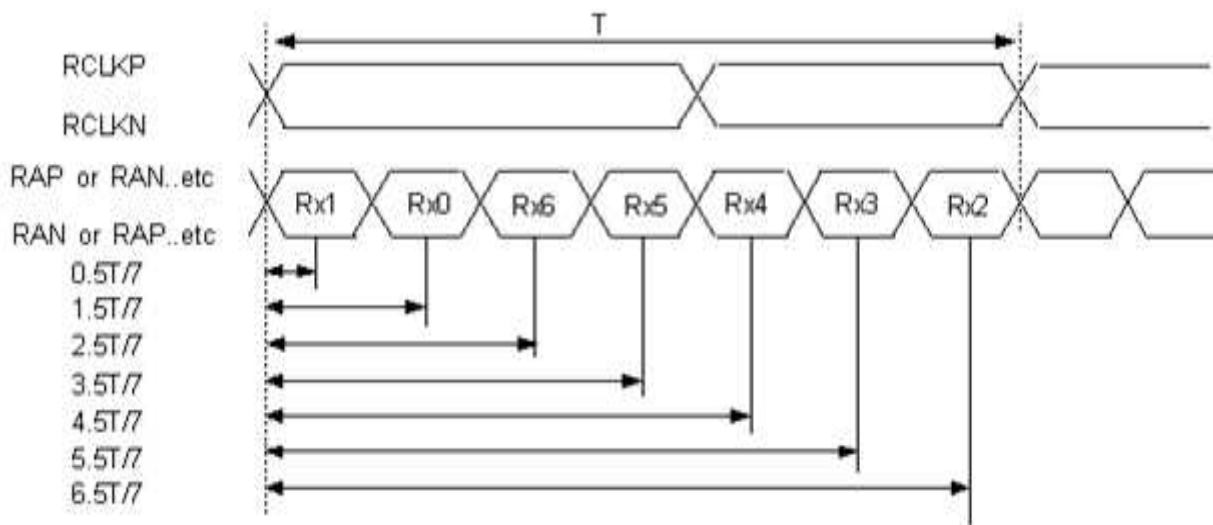
ITEM		SYMBOL	MIN.	TYP.	MAX.	UNIT	NOTE
LVDS input clock frequency		FCLK_LVDS	-	100	-	MHz	
RIN skew margin	$90\text{MHz} > F_{CLK\_LVDS} \geq 65\text{MHz}$	TRSRM	-400	0	400	ps	(1),(2)
	$65\text{MHz} > F_{CLK\_LVDS} \geq 20\text{MHz}$		-600	0	600	ps	(1),(2)
Modulating frequency of LVDS input clock during SSCG		FCLK_MOD	-	-	300	KHz	(3)
Maximum deviation of LVDS input clock during SSCG		FCLK_DEV	-	-	$\pm 3$	%	(3)

Note (1) : LVDS Receiver Skew (Strobe) Margin

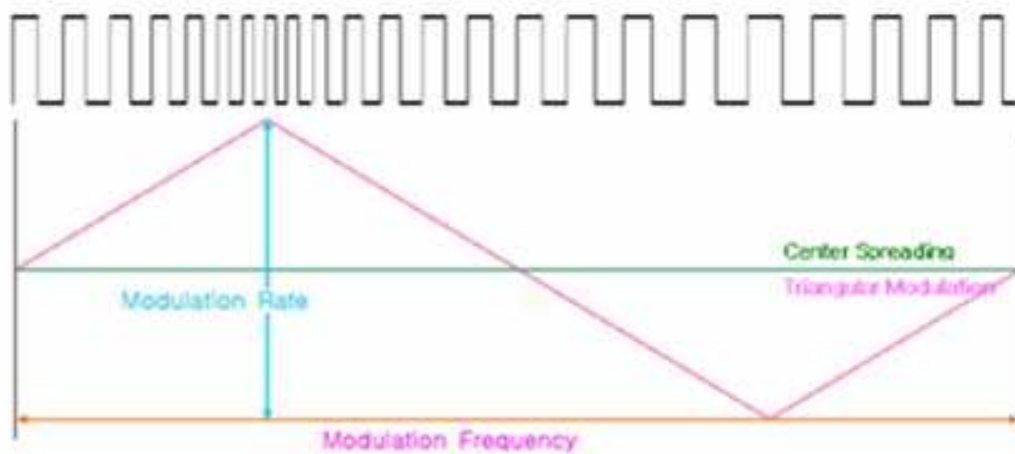


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Note (2) : Ideal Strobe Positions for LVDS Input



Note (3) : SSC ( Spread Spectrum Clock)

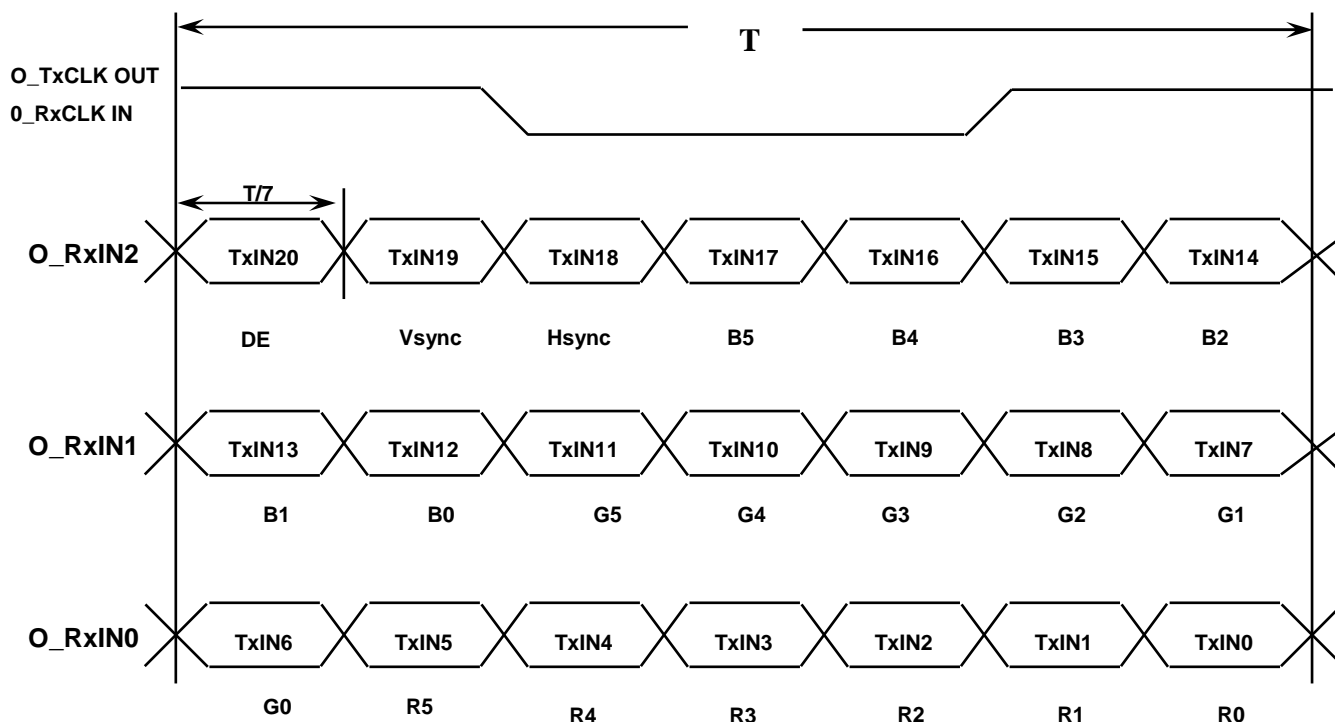


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### 5.3 Timing Diagrams of LVDS For Transmission

#### LVDS Receiver : Integrated T-CON



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## 5.4 Input Signals, Basic Display Colors and Gray Scale of Each Color

Color	Display	Data Signal																Gray Scale Level	
		Red					Green					Blue							
		R0	R1	R2	R3	R4	R5	G0	G1	G2	G3	G4	G5	B0	B1	B2	B3		45
Basic Colors	Black	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	1	1	1	1	1	-
	Green	0	0	0	0	0	0	1	1	1	1	1	1	0	0	0	0	0	-
	Cyan	0	0	0	0	0	0	1	1	1	1	1	1	1	1	1	1	1	-
	Red	1	1	1	1	1	1	0	0	0	0	0	0	0	0	0	0	0	-
	Magenta	1	1	1	1	1	1	0	0	0	0	0	0	1	1	1	1	1	-
	Yellow	1	1	1	1	1	1	1	1	1	1	1	1	0	0	0	0	0	-
	White	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	R0
	Dark	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	R1
	↑	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	R3~R60
	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	
	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	
	↓	1	0	1	1	1	1	0	0	0	0	0	0	0	0	0	0	0	R61
	Light	0	1	1	1	1	1	0	0	0	0	0	0	0	0	0	0	0	R62
	Red	1	1	1	1	1	1	0	0	0	0	0	0	0	0	0	0	0	R63
Gray Scale Of Green	Black	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	G0
	Dark	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	G1
	↑	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	G3~G60
	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	
	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	
	↓	0	0	0	0	0	0	1	0	1	1	1	1	0	0	0	0	0	G61
	Light	0	0	0	0	0	0	0	1	1	1	1	1	0	0	0	0	0	G62
	Green	0	0	0	0	0	0	1	1	1	1	1	1	0	0	0	0	0	G63
Gray Scale Of Blue	Black	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	B0
	Dark	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	B1
	↑	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	B3~B60
	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	
	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	
	↓	0	0	0	0	0	0	0	0	0	0	0	0	1	0	1	1	1	B61
	Light	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1	1	1	B62
	Blue	0	0	0	0	0	0	0	0	0	0	0	0	1	1	1	1	1	B63

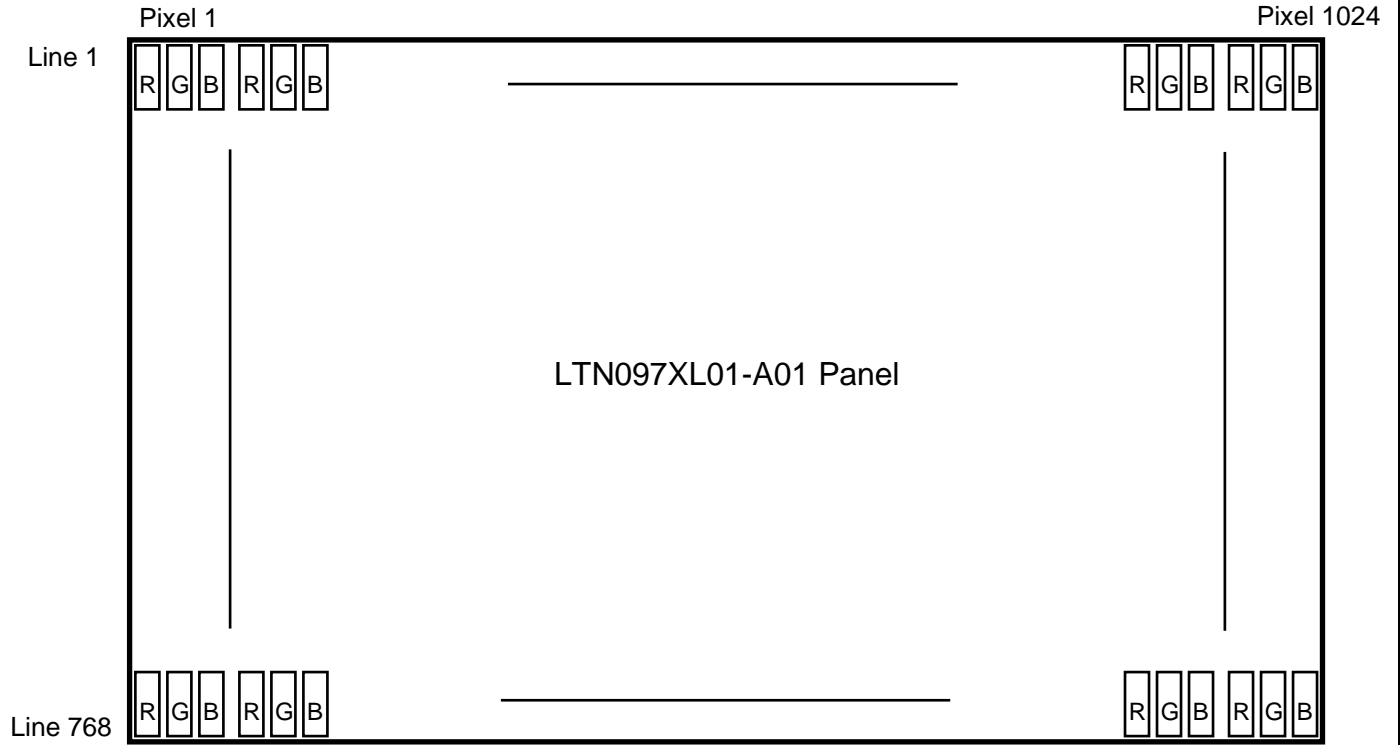
Note 1) Definition of gray :

Rn: Red gray, Gn: Green gray, Bn: Blue gray (n=gray level)

Note 2) Input signal: 0 =Low level voltage, 1=High level voltage

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### 5.5 Pixel Format in the display



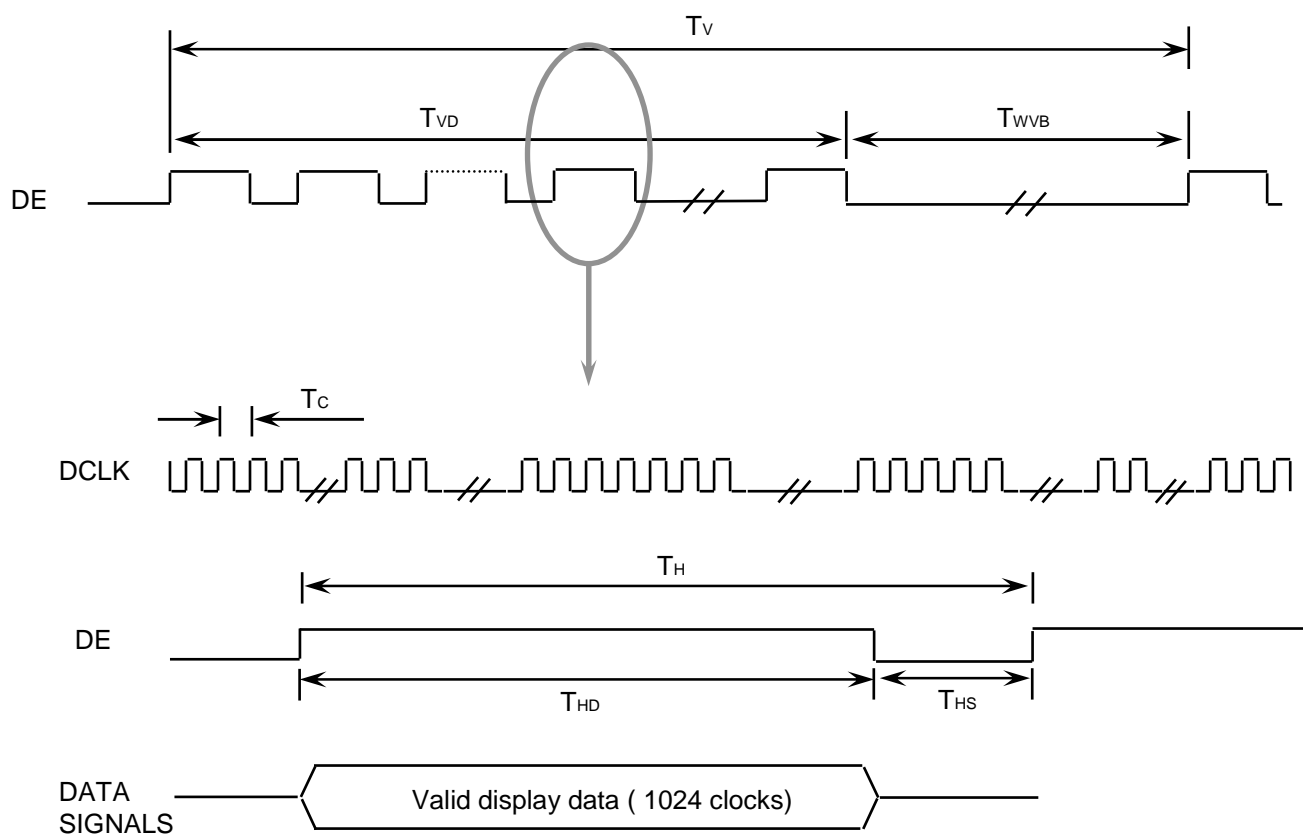
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## 6. INTERFACE TIMING

### 6.1 Timing Parameters

Signal	Item	Symbol	Min.	Typ.	Max.	Unit	Note
Frame Frequency	Cycle	TV	772	800	812	Lines	-
Vertical Active Display Term	Display Period	TVD	-	768	-	Lines	-
One Line Scanning Time	Cycle	TH	-	2084	-	Clocks	-
Horizontal Active Display Term	Display Period	THD	-	1024	-	Pixels	-

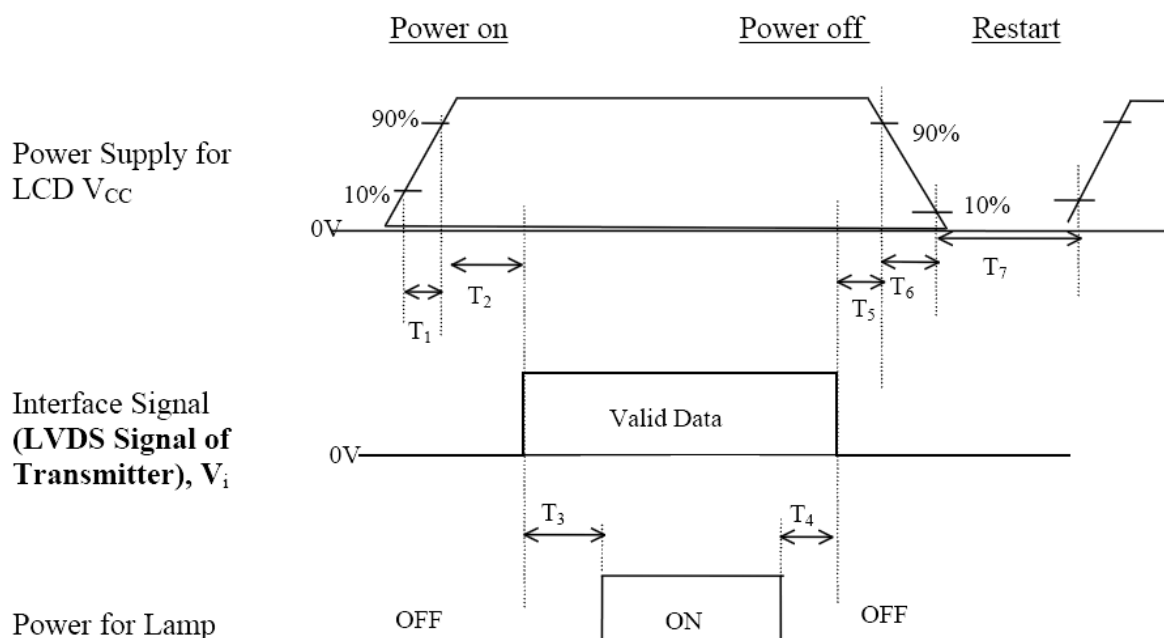
### 6.2 Timing diagrams of interface signal



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### 6.3 Power ON/OFF Sequence

: To prevent a latch-up or DC operation of the LCD module, the power on/off sequence should be as the diagram below.



Parameter	Values			Unit
	Min.	Typ.	Max.	
T <sub>1</sub>	0.5	-	10	ms
T <sub>2</sub>	0	20	50	ms
T <sub>3</sub>	200	250	-	ms
T <sub>4</sub>	200	250	-	ms
T <sub>5</sub>	0.5	20	50	ms
T <sub>6</sub>	0	-	20	ms
T <sub>7</sub>	500	-	-	ms

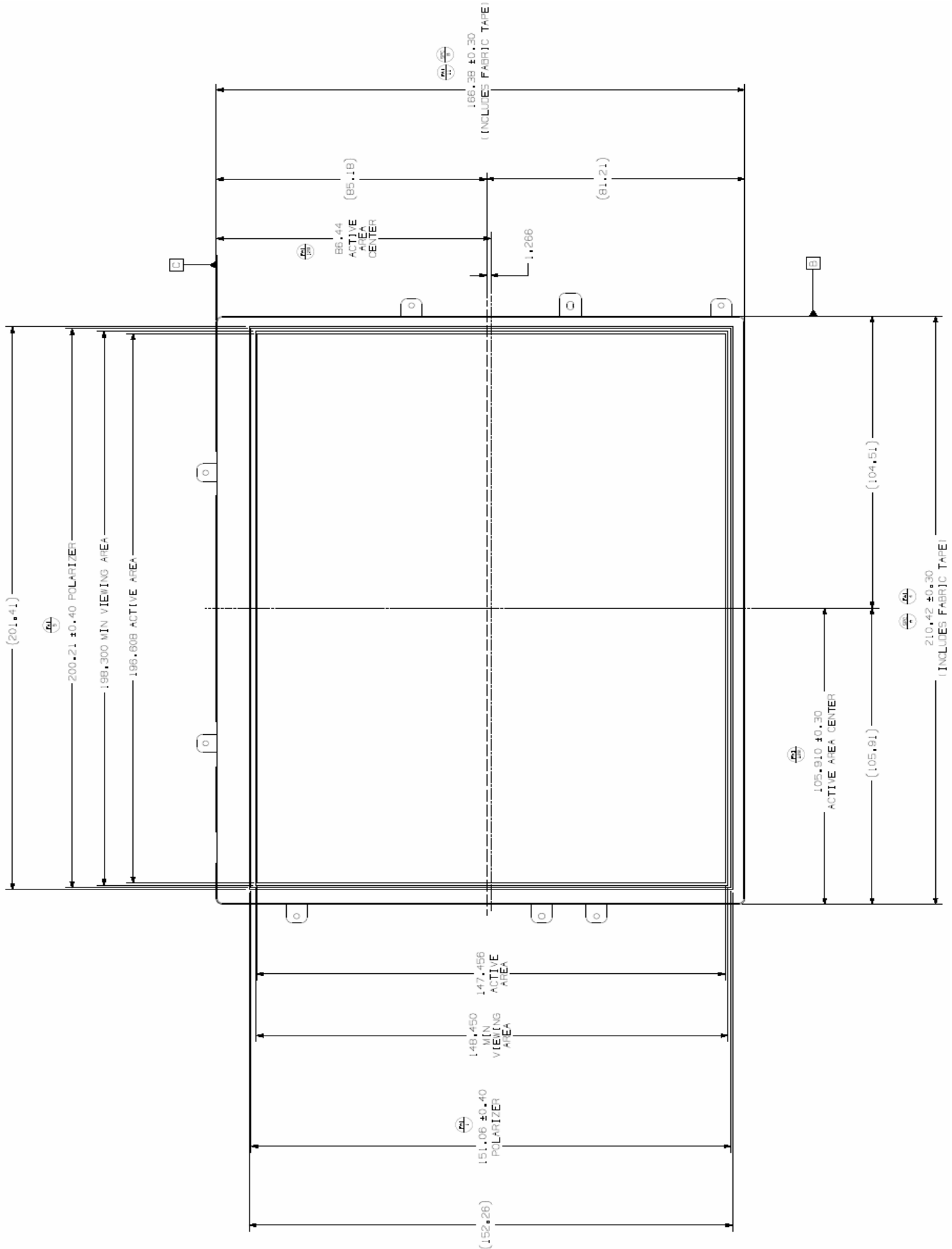
- (1) Do not float interface signal during invalid state.
- (2) V<sub>CC</sub> should be 0V when interface signal is not applied.
- (3) B/L power should be turned on when interface signal is valid state and should be turned off after logic and interface signal go to invalid state.

### Power Sequence & Timing Parameters

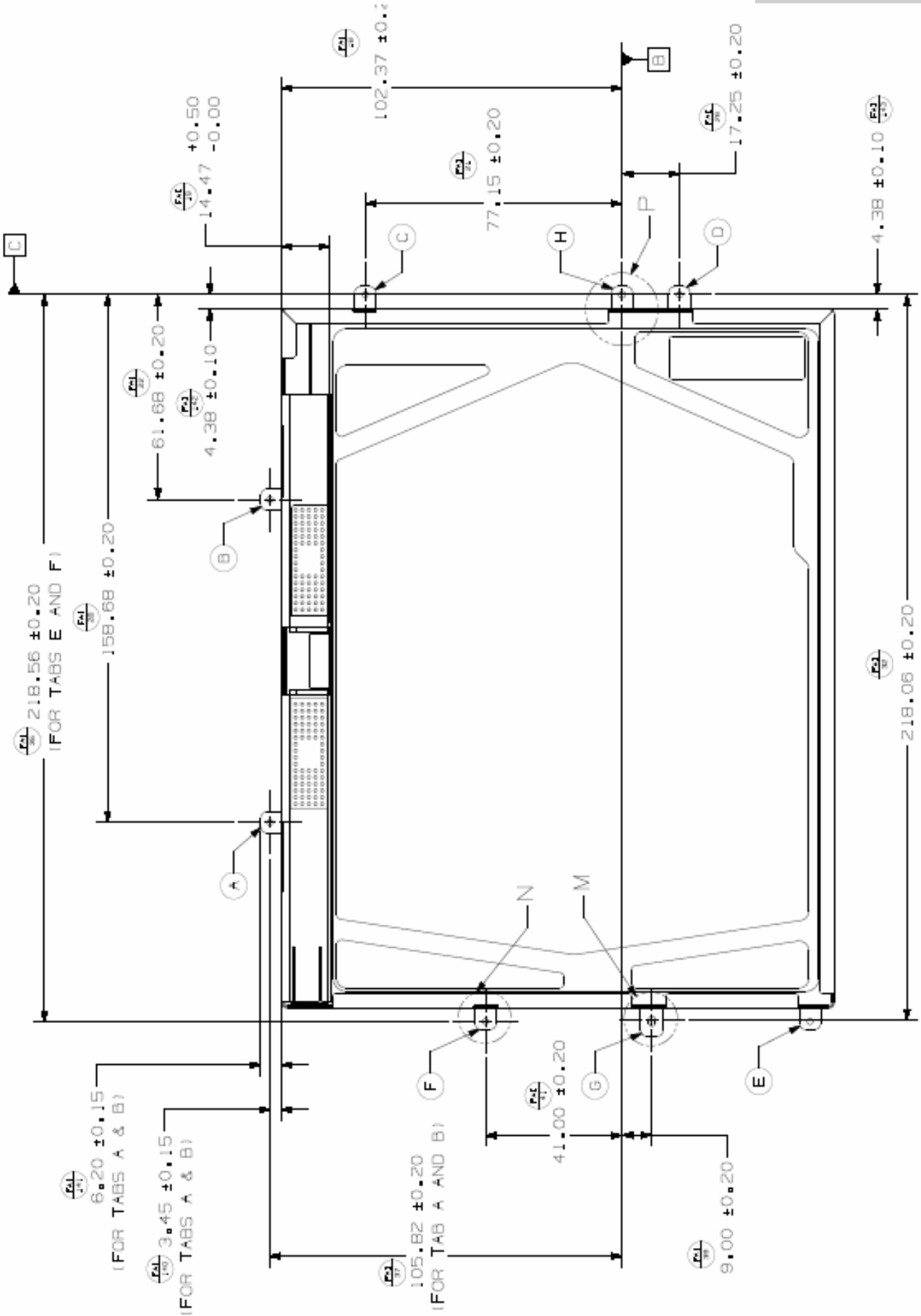
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# 7. MECHANICAL OUTLINE DIMENSION

Approval



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## 8 . GENERAL PRECAUTIONS

### 1. Handling

- (a) When the module is assembled, It should be attached to the system firmly using every mounting holes. Be careful not to twist and bend the modules.
- (b) Refrain from strong mechanical shock and / or any force to the module. In addition to damage, this may cause improper operation or damage to the module and LED back-light.
- (c) Note that polarizers are very fragile and could be easily damaged. Do not press or scratch the surface harder than a HB pencil lead.
- (d) Wipe off water droplets or oil immediately. If you leave the droplets for a long time, Staining and discoloration may occur.
- (e) If the surface of the polarizer is dirty, clean it using some absorbent cotton or soft cloth.
- (f) The desirable cleaners are water, IPA(Isoprophyl Alcohol) or Hexane.  
Do not use Ketone type materials(ex. Acetone), Ethyl alcohol, Toluene, Ethyl acid or Methyl chloride. It might permanent damage to the polarizer due to chemical reaction.
- (g) 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, legs or clothes, it must be washed away thoroughly with soap.
- (h) Protect the module from static, it may cause damage to the C-MOS Gate Array IC.
- (i) Use fingerstalls with soft gloves in order to keep display clean during the incoming inspection and assembly process.
- (j) Do not disassemble the module.
- (k) Do not pull or fold the lamp wire.
- (l) Do not adjust the variable resistor which is located on the back side.
- (m) Protection film for polarizer on the module shall be slowly peeled off just before use so that the electrostatic charge can be minimized.
- (n) Pins of I/F connector shall not be touched directly with bare hands.

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## 2. STORAGE

- (a) Do not leave the module in high temperature, and high humidity for a long time.  
It is highly recommended to store the module with temperature from 0 to 35 °C and relative humidity of less than 70%.
- (b) Do not store the TFT-LCD module in direct sunlight.
- (c) The module shall be stored in a dark place. It is prohibited to apply sunlight or fluorescent light during the store.

## 3. OPERATION

- (a) Do not connect, disconnect the module in the “Power On” condition.
- (b) Power supply should always be turned on/off by following item 6.3 “Power on/off sequence”.
- (c) 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 minimize the interference.
- (d) The FPC cable between the LED chips and its converter power supply shall be a minimized length and be connected directly. The longer cable between the back-light and the converter may cause lower luminance of light source(LED).
- (e) The standard limited warranty is only applicable when the module is used for general notebook applications. If used for purposes other than as specified, SEC is not to be held reliable for the defective operations. It is strongly recommended to contact SEC to find out fitness for a particular purpose.

## 4. OTHERS

- (a) Ultra-violet ray filter is necessary for outdoor operation.
- (b) Avoid condensation of water. It may result in improper operation or disconnection of electrode.
- (c) Do not exceed the absolute maximum rating value. (supply voltage variation, input voltage variation, variation in part contents and environmental temperature, so on)  
Otherwise the module may be damaged.
- (d) If the module displays the same pattern continuously for a long period of time, it can be the situation when the image “sticks” to the screen.
- (e) This module has its circuitry PCB's on the rear side and should be handled carefully in order not to be stressed.

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