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SAMSUNG TFT-LCD PRODUCT INFORMATION

MODEL : LTM270DL02

Note : This is Product Information is subject to change after 3 months of issuing date.

Application Engineering Group

LCD Business, Samsung Electronics Co . , LTD.



SAMSUNG TFT-LCD

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General Description

Description

LTM270DL02 is a color active matrix liquid crystal display (LCD) that uses amorphous silicon TFT (Thin Film Transistor) as switching components. This model is composed of a TFT LCD panel, a driver circuit and a back light unit. The resolution of a 27.0" is 2560 x 1440 and this model can display up to 16.7 millions colors.

Features

- High Color Saturation, high aperture structure
 - PLS mode
 - Wide Viewing Angle
 - QHD (2560 x 1440 pixels) resolution
 - DE (Data Enable) only mode
 - White LED Edge slim Backlight (1-side)
 - RoHS compliance
 - TCO5.0 compliance
- (Except for 2.2 response time; this product does not have over driving function.
It is recommended to support in system level)

Applications

- Workstation & desktop monitors
 - MFM & Graphic application
 - Display terminals for AV application products
 - Financial market
 - Monitors for industrial machine
 - Monitors for HDTV
 - Monitors for Professional Medical machine
- * If the module is used to other applications besides the above, please contact SEC in advance.

General Information

Items	Specification	Unit	Note
Pixel Pitch	0.233(H) x 0.233(W)	mm	
Active Display Area	596.74(H) x 335.66(V)	mm	
Surface Treatment	Haze (TBD)		
Display Colors	16.7M (True 8 bit)	colors	
Number of Pixels	2560 x 1440	pixel	
Pixel Arrangement	RGB vertical stripe		
Display Mode	Normally Black		
Luminance of White	300(Typ.)	cd/m ²	

Mechanical Information

Item		Min.	Typ.	Max.	Unit	Note
Module size	Horizontal (H)	629.5	630.0	630.5	mm	Partially 16.8mm(max) At the connector section
	Vertical (V)	367.7	368.2	368.7	mm	
	Depth (D)			15.8	mm	
Weight		-	-	3200	g	LCD module only

Note (1) Mechanical tolerance is $\pm 0.5\text{mm}$ unless there is a special comment.

1. Absolute Maximum Ratings

If the condition exceeds maximum ratings, it can cause malfunction or unrecoverable damage to the device.

Item	Symbol	Min.	Max.	Unit	Note
Power Supply Voltage	V_{DD}	GND-0.5	5.5	V	
Storage temperature	T_{STG}	-20	60	°C	(1)
Glass surface temperature (Operation condition)	T_{OPR}	0	50	°C	
Shock (non - operating)	S_{nop}	-	50	G	(2)
Vibration (non - operating)	V_{nop}	-	1.5	G	(3)

Note (1) $T_a = 25 \pm 2^\circ\text{C}$

- (1) Temperature and relative humidity range are shown in the figure below.
 - a. 90 % RH Max. ($T_a \leq 39^\circ\text{C}$)
 - b. Maximum wet-bulb temperature at 39°C or less. ($T_a \leq 39^\circ\text{C}$)
 - c. No condensation
- (2) 11ms, sine wave, one time for $\pm X$, $\pm Y$, $\pm Z$ axis
- (3) 10-300 Hz, Sweep rate 10min, 30min for X,Y,Z axis

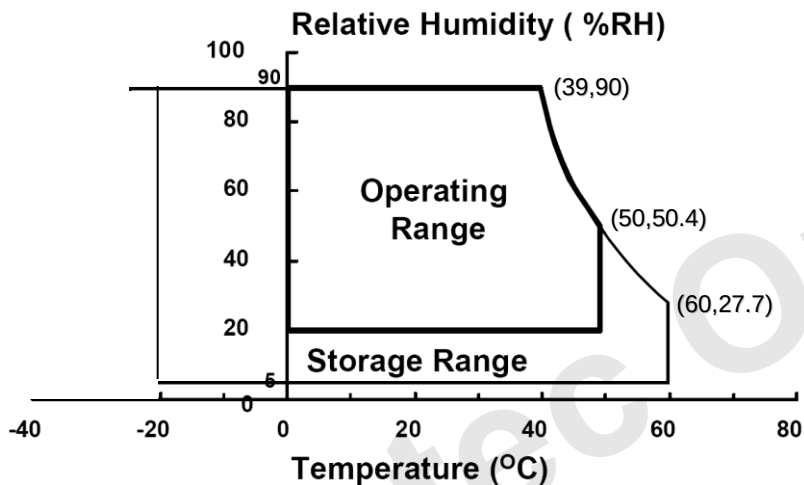


Fig. Temperature and Relative humidity range

2. Optical Characteristics

The optical characteristics should be measured in a dark room or equivalent.

Measuring equipment : SR-3, RD-80S (TOPCON), EZ-Contrast (Eldim)

(Ta = 25 ± 2°C, VDD=5V, fv= 60Hz, Fdclk= 60.38MHz, If = 440 mA)

Item		Symbol	Condition	Min.	Typ.	Max.	Unit	Note
Contrast Ratio (Center of screen)		C/R		600	1,000	-		(3) SR-3
Response Time	On/Off	Tr+Tf	Normal $\theta_{L,R}=0$ $\theta_{u,d}=0$ Viewing Angle	-	12	-	msec	(5) RD-80S
Luminance of White (Center of screen)		Y_L		250	300	-	cd/m ²	(6) SR-3
Color Chromaticity (CIE 1931)	Red	Rx		-0.030	0.660	+0.030		(7),(8) SR-3
		Ry			0.330			
	Green	Gx			0.300			
		Gy			0.630			
	Blue	Bx			0.150			
		By			0.040			
	White	Wx			0.313			
		Wy			0.329			
	Red	Ru'		-	0.468	-		
		Rv'		-	0.527	-		
Color Chromaticity (CIE 1976)	Green	Gu'		-	0.120	-		
		Gv'		-	0.569	-		
	Blue	Bu'		-	0.189	-		
		Bv'		-	0.113	-		
	White	Wu'		-	0.198	-		
		Wv'		-	0.468	-		
C.G.L	White	$\Delta u'v'$		-	-	0.02		(9)

* C.G.L : Color Grayscale Linearity

(continue to the next page)

Item	Symbol	Condition	Min.	Typ.	Max.	Unit	Note
Color Gamut	-		-	72	-	%	
Color Temperature	-		-	6500	-	K	
Viewing Angle	Hor.	θ_L	80	89	-	Degrees	(8) SR-3
		θ_R	80	89	-		
	Ver.	θ_U	80	89	-		
		θ_D	80	89	-		
Brightness Uniformity (9 Points)	B_{uni}		-	-	25	%	(4) SR-3

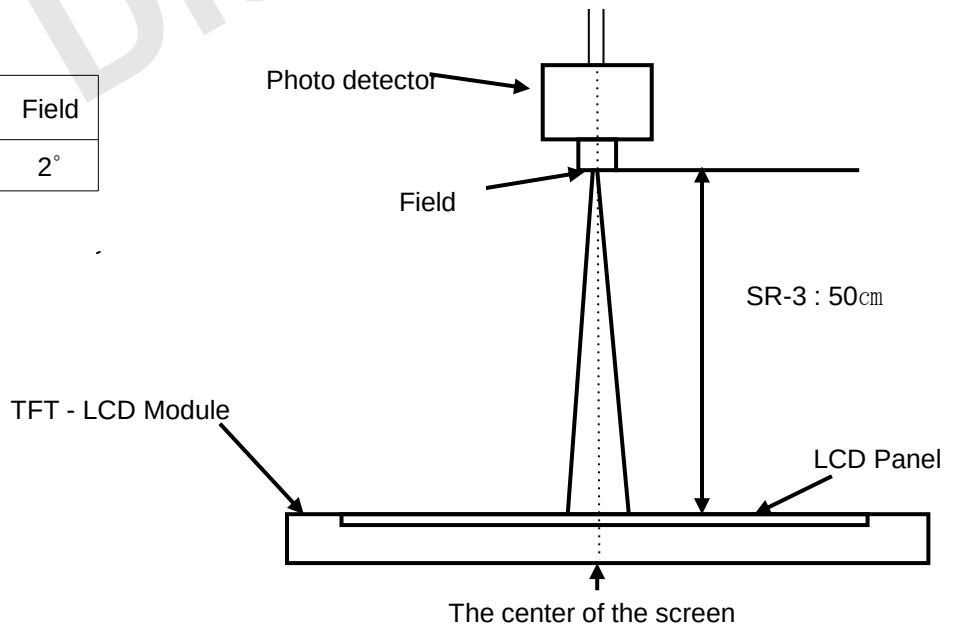
Note (1) Test Equipment Setup

The measurement should be executed in a stable, windless and dark room between 30min after lighting the back light at the given temperature for stabilization of the back light. This should be measured in the center of screen.

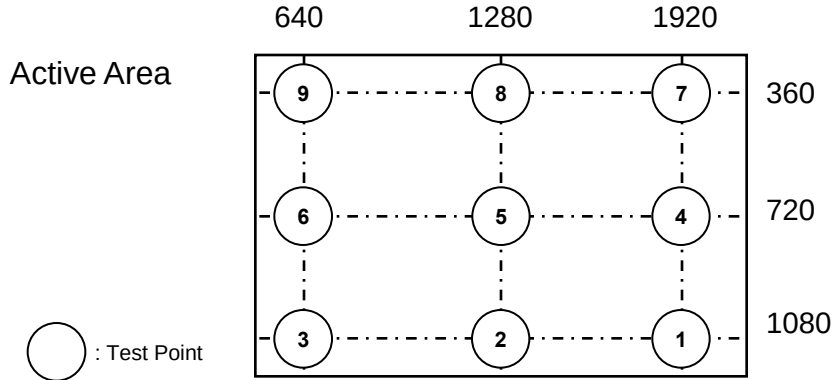
LED current : 440mA

Environment condition : $T_a = 25 \pm 2^\circ\text{C}$

Photo detector	Field
SR-3	2°



Note (2) Definition of test point



Note (3) Definition of Contrast Ratio (C/R)

: Ratio of gray max (Gmax) & gray min (Gmin) at the center point⑤ of the panel

$$CR = \frac{G_{\max}}{G_{\min}}$$

Gmax : Luminance with all pixels white

Gmin : Luminance with all pixels black

Note (4) Definition of 9 points brightness uniformity

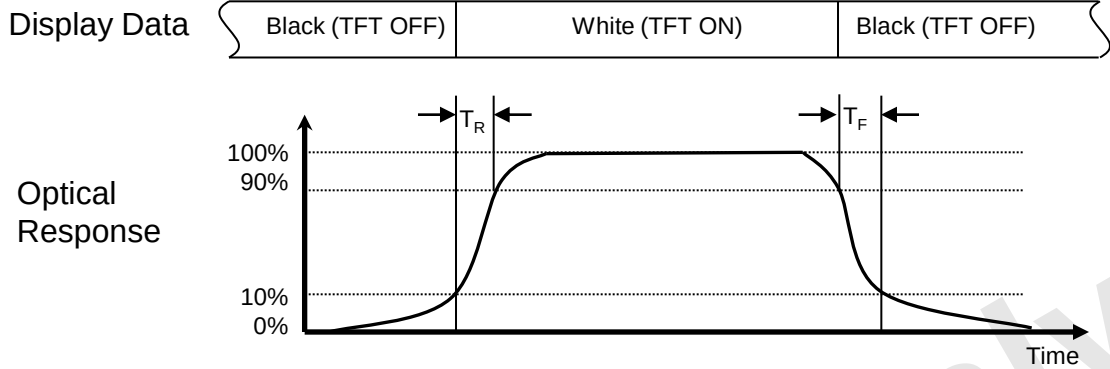
$$B_{uni} = 100 \times \frac{(B_{\max} - B_{\min})}{B_{\max}}$$

Bmax : Maximum brightness with all pixels white

Bmin : Minimum brightness with all pixels white

Note (5) Definition of Response time

a. On/Off response time : Sum of T_r , T_f



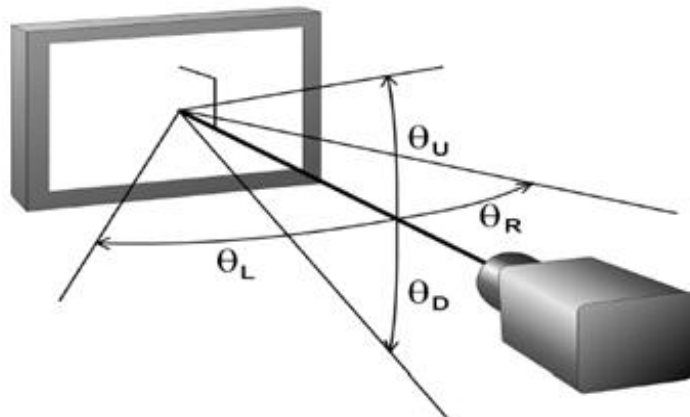
Note (6) Definition of Luminance of White : Luminance of white at center point⑤

Note (7) Definition of Color Chromaticity (CIE 1931, CIE1976)

Color coordinate of Red, Green, Blue & White at center point⑤

Note (8) Definition of Viewing Angle

: Viewing angle range ($CR \geq 10$)



Note (9) Color Grayscale Linearity

- a. Test image : 100% full white pattern with a test pattern as below
- b. Test pattern : Squares, 40mm by 40mm in size, filled with 255, 225, 195, 165, 135 and 105 grays steps should be arranged at the center⑤ of the screen.



c. Test method

- 1st gray step : move a square of 255 gray level should be moved into the center of the screen and measure luminance and u' and v' coordinates.
- Next gray step : Move a 225 gray square into the center and measure both luminance and coordinates, too.

d. Test evaluation

$$\Delta u' v' = \sqrt{(u'_A - u'_B)^2 + (v'_A - v'_B)^2}$$

Where A, B : 2 gray levels found to have the largest color differences between them
i.e. get the largest $\Delta u'$ and $\Delta v'$ of each 6 pair of u' and v' and calculate the $\Delta u' v'$.

3. Electrical Characteristics

3.1 TFT LCD Module

The connector for display data & timing signal should be connected.

$T_a = 25^{\circ}\text{C}$

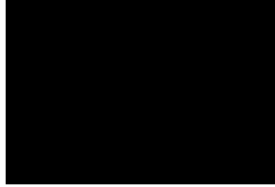
Item		Symbol	Min.	Typ.	Max.	Unit	Note
Voltage of Power Supply		V_{DD}	4.5	5.0	5.5	V	(1)
Interface Type		LVDS	LVDS				
Current of Power Supply	(a) Black	I_{DD}	-	900	-	mA	(2),(3)
	(b) White		-	1400	1700	mA	
	(c) Dot		-	1100	1300	mA	
Vsync Frequency		f_V	45	60	75	Hz	
Hsync Frequency		f_H	66.18	88.79	111.86	kHz	
Main Frequency		f_{DCLK}	45	60.38	76.06	MHz	
Rush Current		I_{RUSH}	-	-	5	A	(4)

- Note (1) The ripple voltage should be controlled under 10% of V_{DD} .
 (2) $f_V=60\text{Hz}$, $f_{DCLK} = 60.38\text{MHz}$, $V_{DD} = 5.0\text{V}$, DC Current.
 (3) Power dissipation check pattern (LCD Module only)

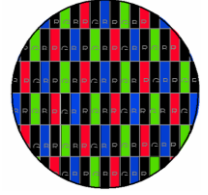
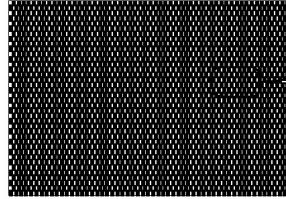
a) White Pattern



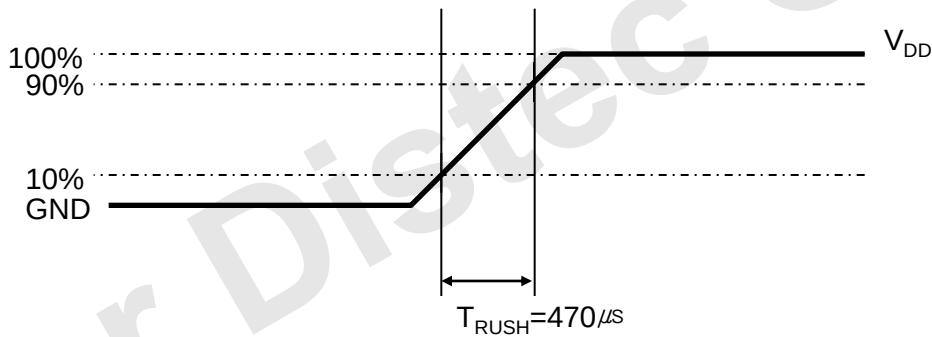
b) Black Pattern



c) Dot Pattern



(4) Measurement Condition



Rush Current I_{RUSH} can be measured when T_{RUSH} is $470\mu s$.

3.2 Back Light Unit

3.2.1 The characteristics of LED bar

The back light unit is composed of WLED.

$T_a = 25 \pm 2^\circ\text{C}$

Item	Symbol	Min.	Typ.	Max.	Unit	Note
LED Forward Current	I_F	-	440	480	mA	(1)
LED Array Voltage	V_P	-	66.0	70.0	V	(1)
Operating Life Time	Hr	30,000	-	-	Hour	(2)

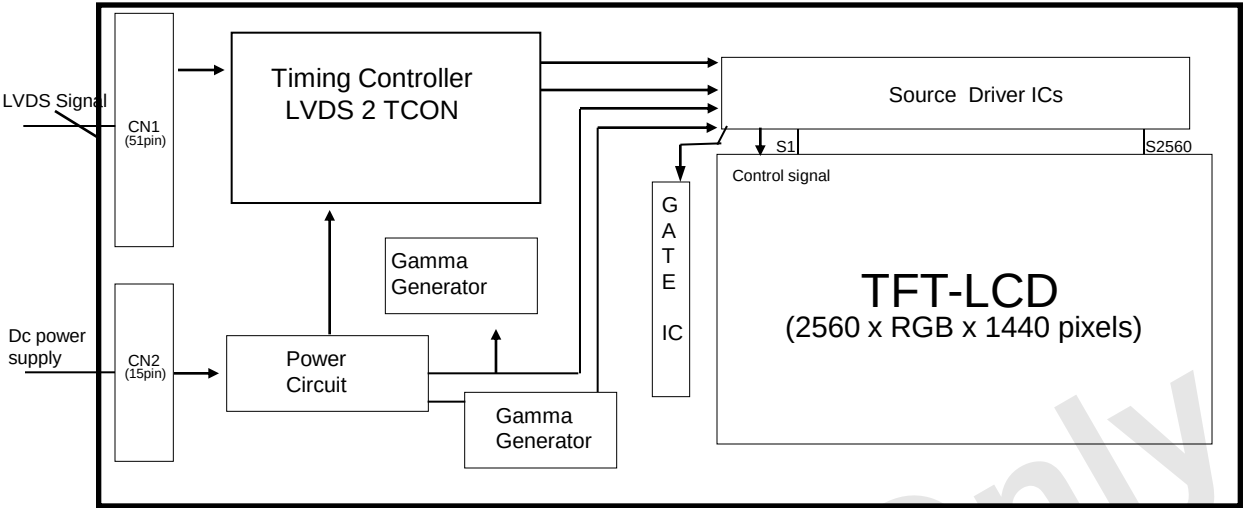
Note (1) The above specification is not for the converter output, but for the LED bar.

The LED bar consists of 80 LED packages ; 4 parallel X 20 serial

(2) Life time(Hr) is defined as the time when brightness of a LED package itself becomes 50% or less than its original value at the condition of $T_a = 25 \pm 2^\circ\text{C}$ and $I_F = 440\text{mA}$

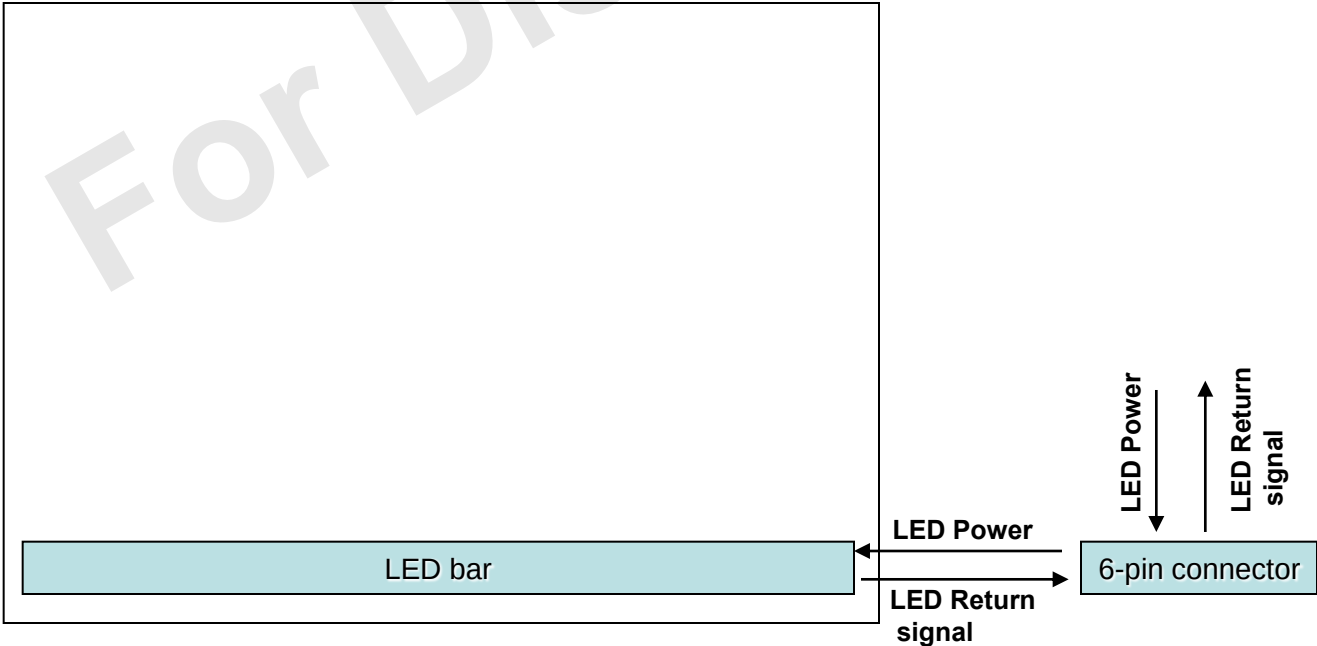
4. BLOCK DIAGRAM

4.1 TFT LCD Module



4.2 Back Light Unit

Connector: Molex 104078-0610 or equivalent



※ For detail connector information, please refer to page 30.

5. Input Terminal Pin Assignment

5.1. Input Signal & Power (Connector : JAE FI-RE51S-HF-J or equivalent)

PIN NO	SYMBOL	FUNCTION
1	B_RXO0N	B_Negative Transmission Data of Pixel 0 (ODD data)
2	B_RXO0P	B_Positive Transmission Data of Pixel 0 (ODD data)
3	B_RXO1N	B_Negative Transmission Data of Pixel 1 (ODD data)
4	B_RXO1P	B_Positive Transmission Data of Pixel 1 (ODD data)
5	B_RXO2N	B_Negative Transmission Data of Pixel 2 (ODD data)
6	B_RXO2P	B_Positive Transmission Data of Pixel 2 (ODD data)
7	GND	Power Ground
8	B_RXOCN	B_Negative Sampling Clock (ODD data)
9	B_RXOCP	B_Positive Sampling Clock (ODD data)
10	GND	Power Ground
11	B_RXO3N	B_Negative Transmission Data of Pixel 3 (ODD data)
12	B_RXO3P	B_Positive Transmission Data of Pixel 3 (ODD data)
13	GND	Power Ground
14	B_RXE0N	B_Negative Transmission Data of Pixel 0 (EVEN data)
15	B_RXE0P	B_Positive Transmission Data of Pixel 0 (EVEN data)
16	B_RXE1N	B_Negative Transmission Data of Pixel 1 (EVEN data)
17	B_RXE1P	B_Positive Transmission Data of Pixel 1 (EVEN data)
18	B_RXE2N	B_Negative Transmission Data of Pixel 2 (EVEN data)
19	B_RXE2P	B_Positive Transmission Data of Pixel 2 (EVEN data)
20	GND	Power Ground
21	B_RXECN	B_Negative Sampling Clock (EVEN data)
22	B_RXECP	B_Positive Sampling Clock (EVEN data)
23	GND	Power Ground
24	B_RXE3N	B_Negative Transmission Data of Pixel 3 (EVEN data)
25	B_RXE3P	B_Positive Transmission Data of Pixel 3 (EVEN data)
26	GND	Power Ground
27~51	Please refer to the next page	

PIN NO	SYMBOL	FUNCTION
27	F_RXO0N	F_Negative Transmission Data of Pixel 0 (ODD data)
28	F_RXO0P	F_Positive Transmission Data of Pixel 0 (ODD data)
29	F_RXO1N	F_Negative Transmission Data of Pixel 1 (ODD data)
30	F_RXO1P	F_Positive Transmission Data of Pixel 1 (ODD data)
31	F_RXO2N	F_Negative Transmission Data of Pixel 2 (ODD data)
32	F_RXO2P	F_Positive Transmission Data of Pixel 2 (ODD data)
33	GND	Power Ground
34	F_RXOCN	F_Negative Sampling Clock (ODD data)
35	F_RXOCP	F_Positive Sampling Clock (ODD data)
36	GND	Power Ground
37	F_RXO3N	F_Negative Transmission Data of Pixel 3 (ODD data)
38	F_RXO3P	F_Positive Transmission Data of Pixel 3 (ODD data)
39	GND	Power Ground
40	F_RXE0N	F_Negative Transmission Data of Pixel 0 (EVEN data)
41	F_RXE0P	F_Positive Transmission Data of Pixel 0 (EVEN data)
42	F_RXE1N	F_Negative Transmission Data of Pixel 1 (EVEN data)
43	F_RXE1P	F_Positive Transmission Data of Pixel 1 (EVEN data)
44	F_RXE2N	F_Negative Transmission Data of Pixel 2 (EVEN data)
45	F_RXE2P	F_Positive Transmission Data of Pixel 2 (EVEN data)
46	GND	Power Ground
47	F_RXECN	F_Negative Sampling Clock (EVEN data)
48	F_RXECP	F_Positive Sampling Clock (EVEN data)
49	GND	Power Ground
50	F_RXE3N	F_Negative Transmission Data of Pixel 3 (EVEN data)
51	F_RXE3P	F_Positive Transmission Data of Pixel 3 (EVEN data)

5.2. Input Power (Connector : YEONHO, 12505WR-15 or Compatible)

PIN NO	SYMBOL	FUNCTION
1	NC	NC
2	NC	NC
3	NC	NC
4	GND	Power Ground
5	GND	Power Ground
6	GND	Power Ground
7	GND	Power Ground
8	NC	* CE(For LCD internal use only. Do not connect)
9	NC	* CTL(For LCD internal use only. Do not connect)
10	GND	Power Ground
11	VDD	Power Supply : +5V
12	VDD	Power Supply : +5V
13	VDD	Power Supply : +5V
14	VDD	Power Supply : +5V
15	VDD	Power Supply : +5V

Note) Pin number starts from Left side

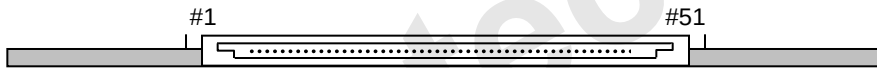
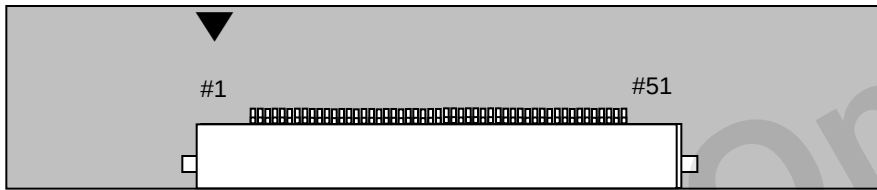
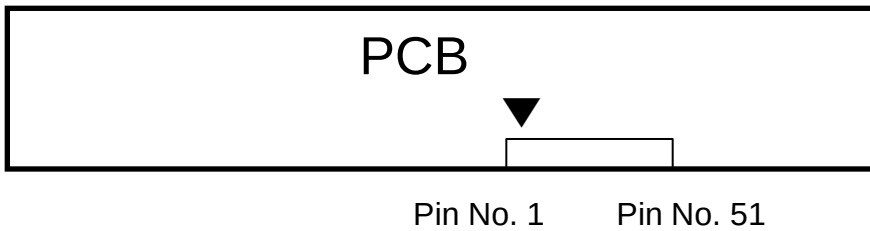


Fig. Connector diagram

- a. All GND pins should be connected together and also be connected to the LCD's metal chassis.
- b. All power input pins should be connected together.
- c. All NC pins should be separated from other signal or power.

5.3 Back Light Unit

LED Bar input connector : Molex 104078-0610 or equivalent

Pin No.	Pin description	Function
1	RTN 1	Channel 1 LED return
2	RTN 2	Channel 2 LED return
3	Vin	LED power input
4	Vin	LED power input
5	RTN 3	Channel 3 LED return
6	RTN 4	Channel 4 LED return

Note) Pin number starts from Left side

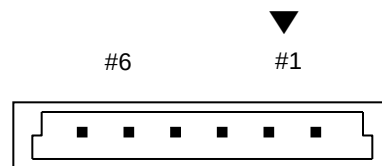
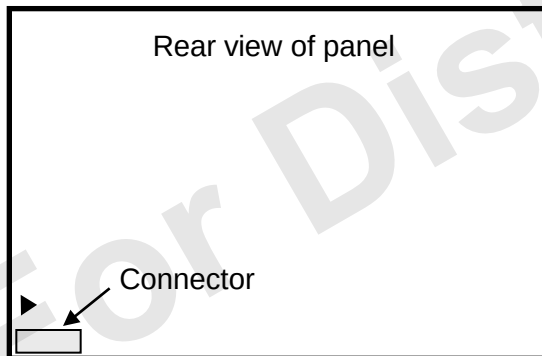


Fig. Connector diagram

5.4 LVDS Interface

5.4.1 Front _ Odd Pixel Data

LVDS Transmitter (THC63LVD103) Signal Interface						
Input pin		Input signal		Output signal	LTM270DL02 interface	
No	symbol	symbol	Function		Terminal	Symbol
59	TD0	F_RO2	Red Odd Pixel Data(LSB)	TD- / TD+	37 / 38	F_RXO3N / F_RXO3P
61	TD1	F_RO3	Red Odd Pixel Data			
33	TA0	F_RO4	Red Odd Pixel Data	TA- / TA+	27 / 28	F_RXO0N / F_RXO0P
34	TA1	F_RO5	Red Odd Pixel Data			
35	TA2	F_RO6	Red Odd Pixel Data			
36	TA3	F_RO7	Red Odd Pixel Data			
37	TA4	F_RO8	Red Odd Pixel Data			
38	TA5	F_RO9	Red Odd Pixel Data(MSB)			
62	TD2	F_GO2	Green Odd Pixel Data(LSB)	TD- / TD+	37 / 38	F_RXO3N / F_RXO3P
63	TD3	F_GO3	Green Odd Pixel Data			
40	TA6	F_GO4	Green Odd Pixel Data	TA- / TA+	27 / 28	F_RXO0N / F_RXO0P
41	TB0	F_GO5	Green Odd Pixel Data	TB- / TB+	29 / 30	F_RXO1N / F_RXO1P
42	TB1	F_GO6	Green Odd Pixel Data			
44	TB2	F_GO7	Green Odd Pixel Data			
45	TB3	F_GO8	Green Odd Pixel Data			
46	TB4	F_GO9	Green Odd Pixel Data(MSB)			
64	TD4	F_BO2	Blue Odd Pixel Data(LSB)	TD- / TD+	37 / 38	F_RXO3N / F_RXO3P
1	TD5	F_BO3	Blue Odd Pixel Data			
48	TB5	F_BO4	Blue Odd Pixel Data	TB- / TB+	29 / 30	F_RXO1N / F_RXO1P
49	TB6	F_BO5	Blue Odd Pixel Data			
50	TC0	F_BO6	Blue Odd Pixel Data	TC- / TC+	31 / 32	F_RXO2N / F_RXO2P
52	TC1	F_BO7	Blue Odd Pixel Data			
53	TC2	F_BO8	Blue Odd Pixel Data			
54	TC3	F_BO9	Blue Odd Pixel Data(MSB)			

5.4 LVDS Interface

5.4.2 Front _ Even Pixel Data

LVDS Transmitter (THC63LVD103) Signal Interface						
Input pin		Input signal		Output signal	LTM270DL02 interface	
No	symbol	symbol	Function		Terminal	Symbol
59	TD0	F_RE2	Red Even Pixel Data(LSB)	TD- / TD+	50 / 51	F_RXE3N / F_RXE3P
61	TD1	F_RE3	Red Even Pixel Data			
33	TA0	F_RE4	Red Even Pixel Data	TA- / TA+	40 / 41	F_RXE0N / F_RXE0P
34	TA1	F_RE5	Red Even Pixel Data			
35	TA2	F_RE6	Red Even Pixel Data			
36	TA3	F_RE7	Red Even Pixel Data			
37	TA4	F_RE8	Red Even Pixel Data			
38	TA5	F_RE9	Red Even Pixel Data(MSB)			
62	TD2	F_GE2	Green Even Pixel Data(LSB)	TD- / TD+	50 / 51	F_RXE3N / F_RXE3P
63	TD3	F_GE3	Green Even Pixel Data			
40	TA6	F_GE4	Green Even Pixel Data	TA- / TA+	40 / 41	F_RXE0N / F_RXE0P
41	TB0	F_GE5	Green Even Pixel Data	TB- / TB+	42 / 43	F_RXE1N / F_RXE1P
42	TB1	F_GE6	Green Even Pixel Data			
44	TB2	F_GE7	Green Even Pixel Data			
45	TB3	F_GE8	Green Even Pixel Data			
46	TB4	F_GE9	Green Even Pixel Data(MSB)			
64	TD4	F_BE2	Blue Even Pixel Data(LSB)	TD- / TD+	50 / 51	F_RXE3N / F_RXE3P
1	TD5	F_BE3	Blue Even Pixel Data			
48	TB5	F_BE4	Blue Even Pixel Data	TB- / TB+	42 / 43	F_RXE1N / F_RXE1P
49	TB6	F_BE5	Blue Even Pixel Data			
50	TC0	F_BE6	Blue Even Pixel Data	TC- / TC+	44 / 45	F_RXE2N / F_RXE2P
52	TC1	F_BE7	Blue Even Pixel Data			
53	TC2	F_BE8	Blue Even Pixel Data			
54	TC3	F_BE9	Blue Even Pixel Data(MSB)			

5.4 LVDS Interface

5.4.3 Back _ Odd Pixel Data

LVDS Transmitter (THC63LVD103) Signal Interface						
Input pin		Input signal		Output signal	LTM270DL02 interface	
No	symbol	symbol	Function		Terminal	Symbol
59	TD0	B_RO2	Red Odd Pixel Data(LSB)	TD- / TD+		B_RXO3N / B_RXO3P
61	TD1	B_RO3	Red Odd Pixel Data			
33	TA0	B_RO4	Red Odd Pixel Data	TA- / TA+	1 / 2	B_RXO0N / B_RXO0P
34	TA1	B_RO5	Red Odd Pixel Data			
35	TA2	B_RO6	Red Odd Pixel Data			
36	TA3	B_RO7	Red Odd Pixel Data			
37	TA4	B_RO8	Red Odd Pixel Data			
38	TA5	B_RO9	Red Odd Pixel Data(MSB)			
62	TD2	B_GO2	Green Odd Pixel Data(LSB)	TD- / TD+	11 / 12	B_RXO3N / B_RXO3P
63	TD3	B_GO3	Green Odd Pixel Data			
40	TA6	B_GO4	Green Odd Pixel Data	TA- / TA+	1 / 2	B_RXO0N / B_RXO0P
41	TB0	B_GO5	Green Odd Pixel Data	TB- / TB+	3 / 4	B_RXO1N / B_RXO1P
42	TB1	B_GO6	Green Odd Pixel Data			
44	TB2	B_GO7	Green Odd Pixel Data			
45	TB3	B_GO8	Green Odd Pixel Data			
46	TB4	B_GO9	Green Odd Pixel Data(MSB)			
64	TD4	B_BO2	Blue Odd Pixel Data(LSB)	TD- / TD+	11 / 12	B_RXO3N / B_RXO3P
1	TD5	B_BO3	Blue Odd Pixel Data			
48	TB5	B_BO4	Blue Odd Pixel Data	TB- / TB+	3 / 4	B_RXO1N / B_RXO1P
49	TB6	B_BO5	Blue Odd Pixel Data			
50	TC0	B_BO6	Blue Odd Pixel Data	TC- / TC+	5 / 6	B_RXO2N / B_RXO2P
52	TC1	B_BO7	Blue Odd Pixel Data			
53	TC2	B_BO8	Blue Odd Pixel Data			
54	TC3	B_BO9	Blue Odd Pixel Data(MSB)			

5.4 LVDS Interface

5.4.4 Back _ Even Pixel Data

LVDS Transmitter (THC63LVD103) Signal Interface						
Input pin		Input signal		Output signal	LTM270DL02 interface	
No	symbol	symbol	Function		Terminal	Symbol
59	TD0	RE2	Red Even Pixel Data(LSB)	TD- / TD+		B_RXE3N / B_RXE3P
61	TD1	B_RE3	Red Even Pixel Data			
33	TA0	B_RE4	Red Even Pixel Data	TA- / TA+	14 / 15	B_RXE0N / B_RXE0P
34	TA1	B_RE5	Red Even Pixel Data			
35	TA2	B_RE6	Red Even Pixel Data			
36	TA3	B_RE7	Red Even Pixel Data			
37	TA4	B_RE8	Red Even Pixel Data			
38	TA5	B_RE9	Red Even Pixel Data(MSB)			
62	TD2	B_GE2	Green Even Pixel Data(LSB)	TD- / TD+	24 / 25	B_RXE3N / B_RXE3P
63	TD3	B_GE3	Green Even Pixel Data			
40	TA6	B_GE4	Green Even Pixel Data	TA- / TA+	14 / 15	B_RXE0N / B_RXE0P
41	TB0	B_GE5	Green Even Pixel Data	TB- / TB+	16 / 17	B_RXE1N / B_RXE1P
42	TB1	B_GE6	Green Even Pixel Data			
44	TB2	B_GE7	Green Even Pixel Data			
45	TB3	B_GE8	Green Even Pixel Data			
46	TB4	B_GE9	Green Even Pixel Data(MSB)			
64	TD4	B_BE2	Blue Even Pixel Data(LSB)	TD- / TD+	24 / 25	B_RXE3N / B_RXE3P
1	TD5	B_BE3	Blue Even Pixel Data			
48	TB5	B_BE4	Blue Even Pixel Data	TB- / TB+	16 / 17	B_RXE1N / B_RXE1P
49	TB6	B_BE5	Blue Even Pixel Data			
50	TC0	B_BE6	Blue Even Pixel Data	TC- / TC+	18 / 19	B_RXE2N / B_RXE2P
52	TC1	B_BE7	Blue Even Pixel Data			
53	TC2	B_BE8	Blue Even Pixel Data			
54	TC3	B_BE9	Blue Even Pixel Data(MSB)			

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

COLO R	DISPLAY (8bit)	DATA SIGNAL																										GRAY SCALE LEVEL
		RED								GREEN								BLUE										
		R0	R1	R2	R3	R4	R5	R6	R7	G0	G 1	G 2	G3	G 4	G 5	G6	G 7	B0	B1	B2	B3	B4	B5	B6	B7			
BASIC COLO R	BLACK	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	-		
	BLUE	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1	1	1	1	1	1	1	-		
	GREEN	0	0	0	0	0	0	0	0	1	1	1	1	1	1	1	1	0	0	0	0	0	0	0	0	-		
	CYAN	0	0	0	0	0	0	0	0	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	-		
	RED	1	1	1	1	1	1	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	-		
	MAGENT A	1	1	1	1	1	1	1	1	0	0	0	0	0	0	0	0	1	1	1	1	1	1	1	1	-		
	YELLOW	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	0	0	0	0	0	0	0	0	-		
	WHITE	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	-		
GRAY SCALE OF RED	BLACK	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	R0		
	DARK ↑ ↓ LIGHT	1	0	0	0	0	0	0	0	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	0	0	0	0	0	0	0	R2		
		:	:	:	:	:	:			:	:	:	:	:	:			:	:	:	:	:	:			R3~ R252		
		:	:	:	:	:	:			:	:	:	:	:	:			:	:	:	:	:	:					
		1	0	1	1	1	1	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	R253	
	0	1	1	1	1	1	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	R254		
	RED	1	1	1	1	1	1	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	R255		
GRAY SCALE OF GREE N	BLACK	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	G0		
	DARK ↑ ↓ LIGHT	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	G1		
		0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	G2		
		:	:	:	:	:	:			:	:	:	:	:	:			:	:	:	:	:	:			G3~ G252		
		:	:	:	:	:	:			:	:	:	:	:	:			:	:	:	:	:	:					
		0	0	0	0	0	0	0	0	1	0	1	1	1	1	1	1	1	0	0	0	0	0	0	0	0	G253	
	0	0	0	0	0	0	0	0	0	1	1	1	1	1	1	1	1	0	0	0	0	0	0	0	0	G254		
	GREEN	0	0	0	0	0	0	0	0	1	1	1	1	1	1	1	1	0	0	0	0	0	0	0	0	G255		
GRAY SCALE OF BLUE	BLACK	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	B0		
	DARK ↑ ↓ LIGHT	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	B1		
		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	B2		
		:	:	:	:	:	:			:	:	:	:	:	:			:	:	:	:	:	:			B3~ B252		
		:	:	:	:	:	:			:	:	:	:	:	:			:	:	:	:	:	:					
		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	1	1	1	1	1	1	B253	
	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1	1	1	1	1	1	1	B254		
	BLUE	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1	1	1	1	1	1	1	B255		

Note (1) Definition of Gray :

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

Input Signal : 0 = Low level voltage, 1 = High level voltage

6. Interface Timing

6.1 Timing Parameters (DE only mode)

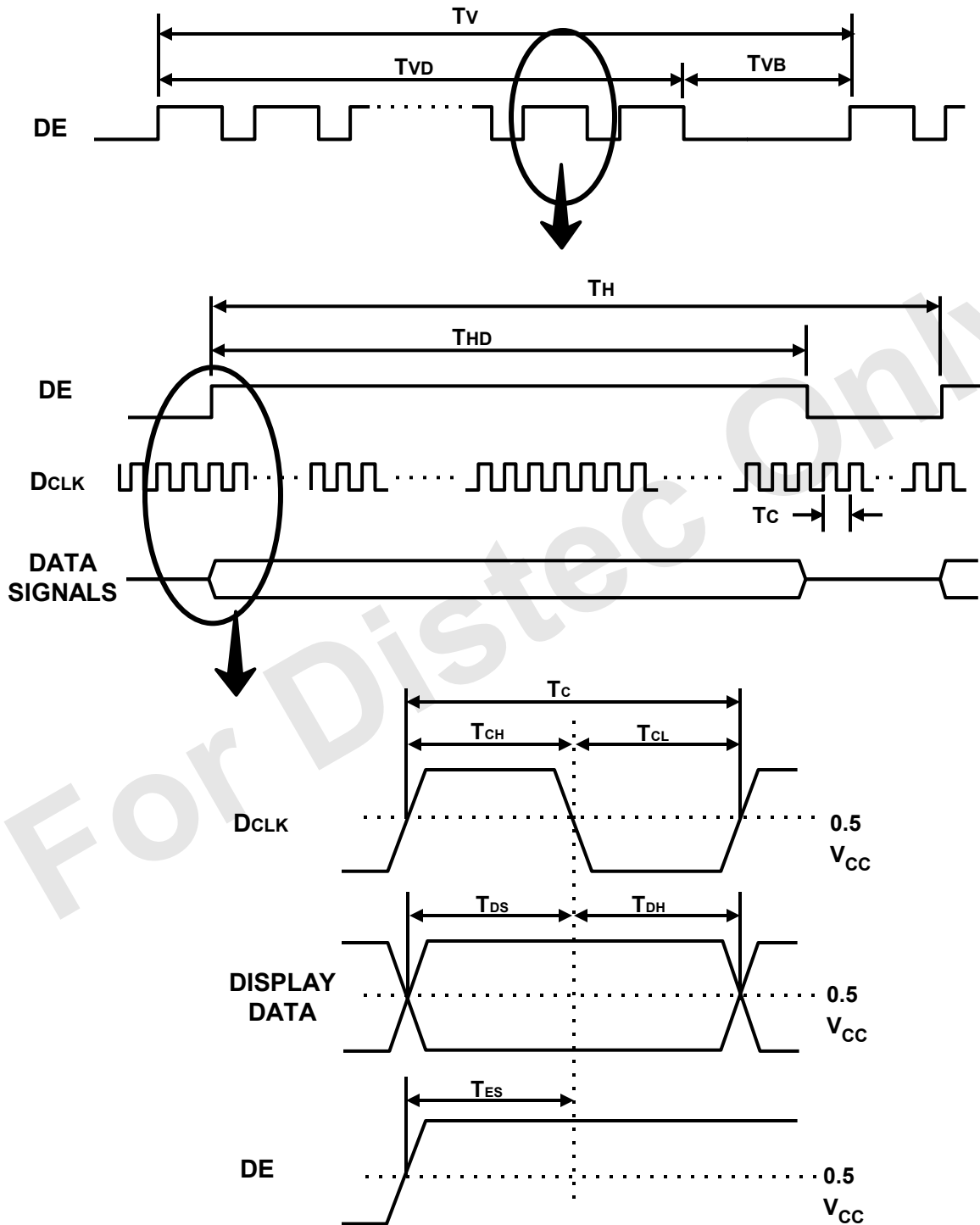
SIGNAL	ITEM	SYMBOL	MIN.	TYP.	MAX.	Unit	NOTE
Clock	Frequency	$1/T_C$	45.00	60.38	76.06	MHz	-
Hsync		F_H	66.18	88.79	111.86	KHz	-
Vsync		F_V	45	60	75	Hz	-
Vertical Display Term	Active Display Period	T_{VD}	1440	1440	1440	lines	-
	Vertical Total	T_{VB}	1471	1481	1492	lines	-
Horizontal Display Term	Active Display Period	T_{HD}	640	640	640	Pixels	4pixel /clock
	Horizontal Total	T_H	-	680	-	Pixels	4pixel /clock

Note (1) This product is DE only mode. The input of Hsync & Vsync signal does not have an effect on normal operation.

(2) Test Point : TTL control signal and CLK at LVDS Tx input terminal in system

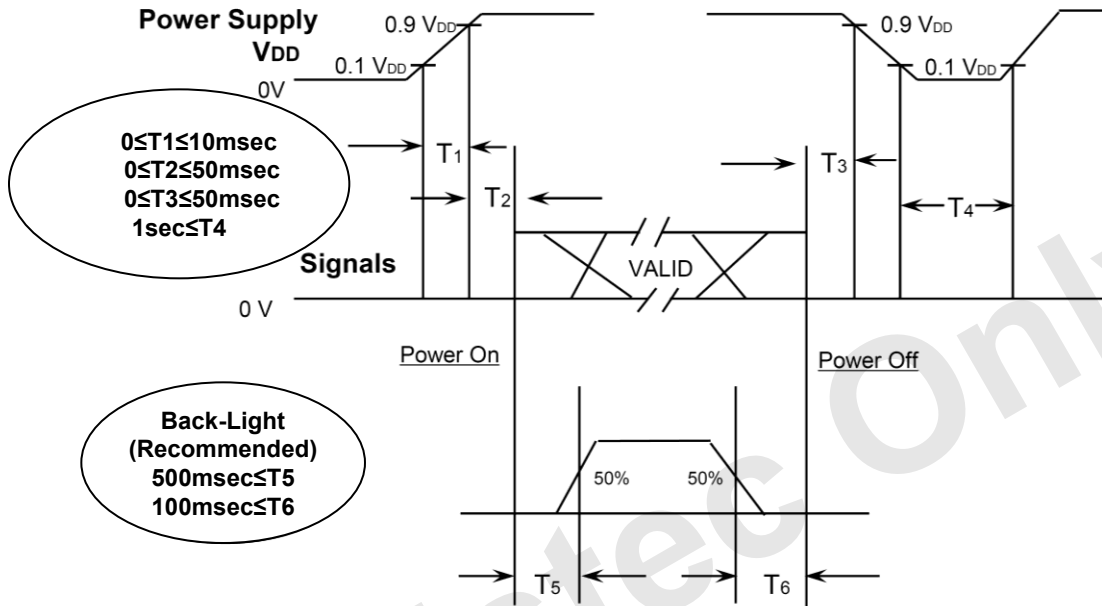
(3) Internal Vcc = 5.0V

6.2 Timing diagrams of interface signal (DE only mode)



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.



T_1 : V_{DD} rising time from 10% to 90%

T_2 : The time from V_{DD} to valid data at power ON.

T_3 : The time from valid data off to V_{DD} off at power Off.

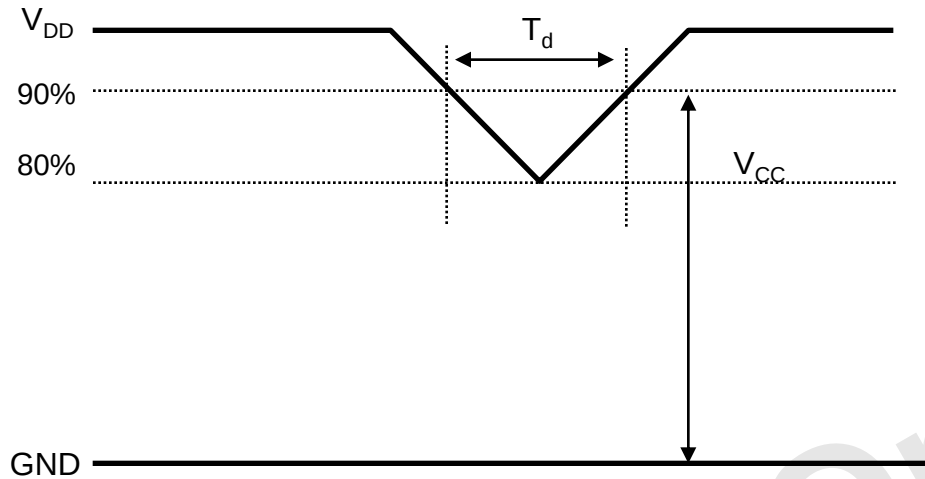
T_4 : V_{DD} off time for Windows restart

T_5 : The time from valid data to B/L enable at power ON.

T_6 : The time from valid data off to B/L disable at power Off.

- The supply voltage of the external system for the Module input should be the same as the definition of V_{DD} .
- Apply the lamp voltage within the LCD operation range. When the back light turns on before the LCD operation or the LCD turns off before the back light turns off, the display may momentarily show abnormal screen.
- In case of V_{DD} = off level, please keep the level of input signals low or keep a high impedance.
- T_4 should be measured after the Module has been fully discharged between power off and on period.
- Interface signal should not be kept at high impedance when the power is on.

6.4 VDD Power Dip Sequence



$4.5V \leq V_{DD} \leq 5.5V$
 If $V_{DD}(\text{typ.}) \times 80\% \leq V_{CC} \leq V_{DD}(\text{typ.}) \times 90\%$,
 then $0 < T_d \leq 20\text{msec}$

- Note (1) The above conditions are for the glitch of the input voltage.
- (2) For stable operation of an LCD Module power, please follow them.
- i.e., if $\text{typ VDD} \times 80\% \leq V_{CC} \leq \text{typ VDD} \times 90\%$, then T_d should be less than 20ms.

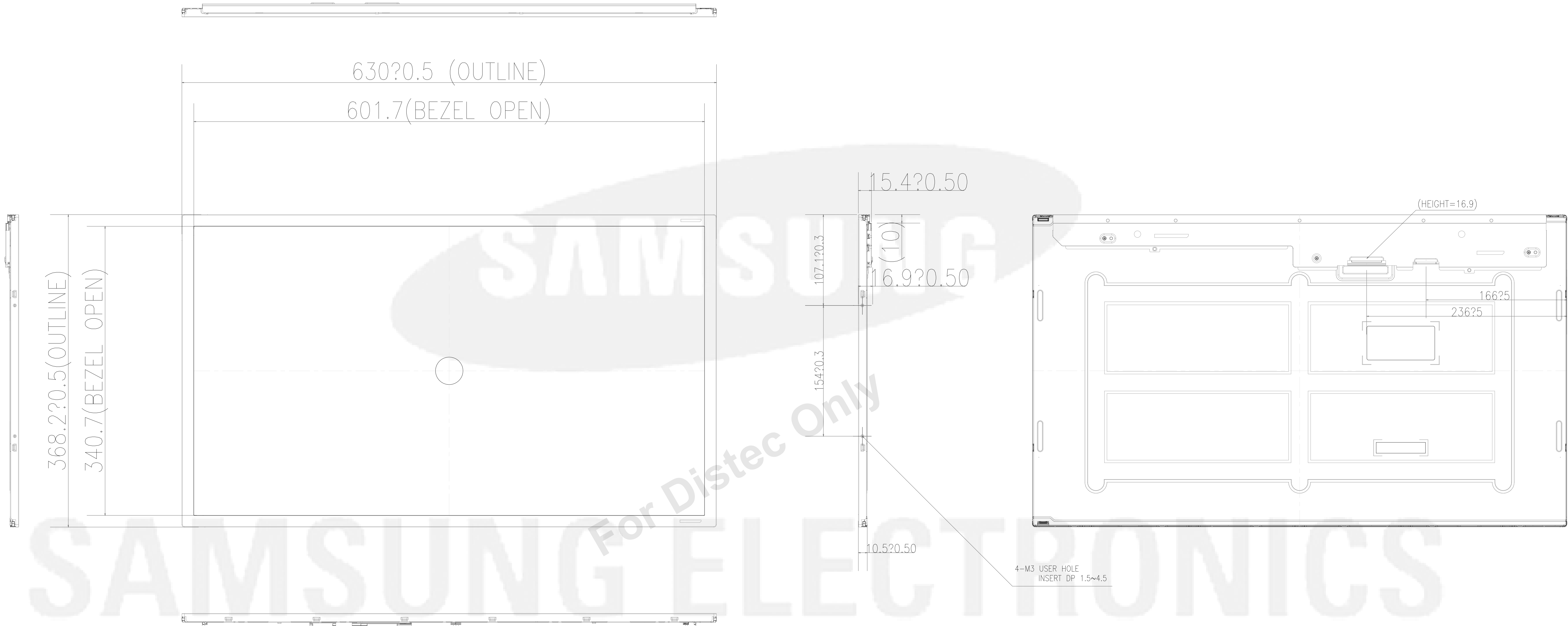
7. Outline Dimension

[Refer to the next page]

For Distec Only

FILE NO.	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S
----------	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---

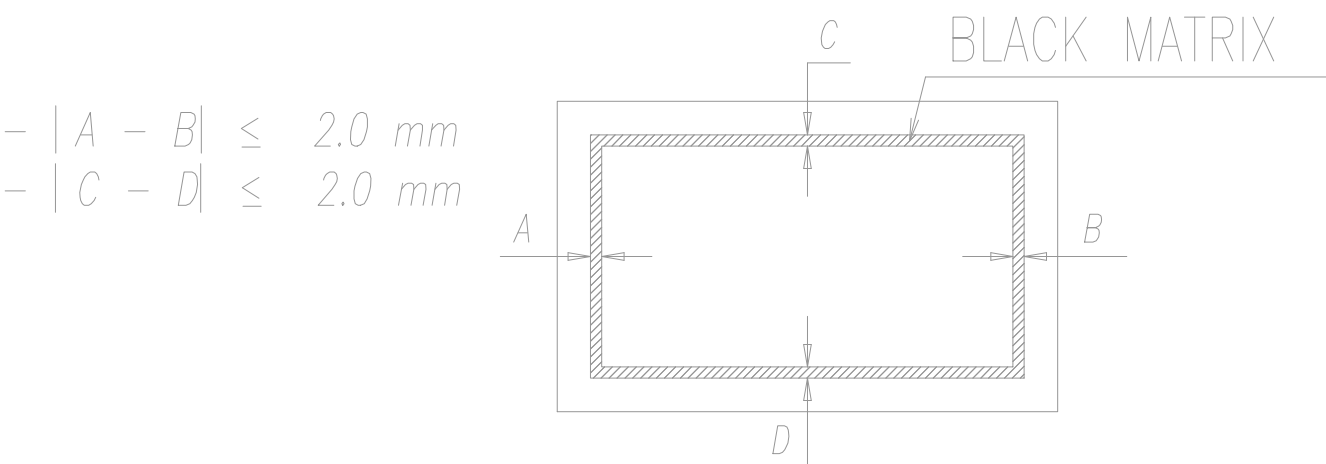
NO.	T	U	V	W
PART NAME	CODE NO	SPECIFICATION	QTY	REMARK



10075237

* NOTES

- BACKLIGHT : WHITE LED
- I/F CONNECTOR SPECIFICATION.
 - MAKER: Melex
 - PART NO: 3708-002867
 - OR equivalent
- SCREW TORQUE SPEC : TBD
- BLACK MATRIX SPEC



FOR REVIEW

GENERAL TOLERANCE				REV	DATE	DESCRIPTION OF REVISION			REASON	CH'D BY
STEP	LEVEL 1	LEVEL 2	LEVEL 3	UNIT	mm	DRAWN BY	DES'D BY	CHK'D BY	MODEL NAME	
0 < X ≤ 4	±0.05	±0.1	±0.2	SCALE	1:1	S.D.BAE			PART/SHEET NAME	LTM270DLO2
4 < X ≤ 16	±0.06	±0.15	±0.3	TOLERANCE	±1					
16 < X ≤ 64	±0.12	±0.25	±0.5							
64 < X ≤ 256	±0.25	±0.4	±0.8							

CODE NO.	SPEC. NO.	VER.	DO.

8. General Precautions

8.1 Handling

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

8.2 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 5 to 40 °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.
- (d) Storage period is recommended not to exceed 1 year.

8.3 Operation

- (a) Do not connect or disconnect the Module in the "Power On" condition.
- (b) Power supply should always be turned on/off by the item 6.3 "Power on/off sequence"
- (c) Module has high frequency circuits. Sufficient suppression to the electromagnetic interference should be done by system manufacturers. Grounding and shielding methods may be important to minimize the interference.

8.4 Operation Condition Guide

- (a) The LCD product should be operated under normal conditions.
Normal condition is defined as below;
 - Temperature : $20 \pm 15^{\circ}\text{C}$
 - Humidity : $65 \pm 20\%$
 - Display pattern : continually changing pattern (Not stationary)
- (b) If the product will be used in extreme conditions such as high temperature, humidity, display patterns or operation time etc., It is strongly recommended to contact SEC for Application engineering advice. Otherwise, its reliability and function may not be guaranteed. Extreme conditions are commonly found at Airports, Transit Stations, Banks, Stock market, and Controlling systems.

8.5 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, and so on)
Otherwise the Module may be damaged.
- (d) If the Module keeps displaying the same pattern for a long period of time, the image may be "stuck" to the screen.
To avoid image sticking, it is recommended to use a screen saver.
- (e) This Module has its circuitry PCB's on the rear side and should be handled carefully in order not to be stressed.
- (f) Please contact SEC in advance when you display the same pattern for a long time.