

**Samsung Secret**

Product Information

DATE : 28. Mar. 2012**SAMSUNG TFT-LCD****MODEL : LTA320XXXX (HD, 60HZ)****LTY[Z]320AN03**

The Information Described in this Specification is Preliminary and can be changed without prior notice

LCD Business

Samsung Electronics Co . , LTD.

MODEL

LTA320XXXX_HD60

Doc. No

05-000-G-20120328

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**Samsung Secret***** Revision History**

Date	Rev. No	Page	Summary
28. Mar. 2012	000	-	First Issued

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General Description

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Description

LTA320XXXX 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 32.0" is 1366 x 768 and this model can display up to 16.7 million colors with wide viewing angle of 89° or higher in all directions. This panel is intended to support applications to provide an excellent performance for Flat Panel Display such as Home-alone Multimedia TFT-LCD TV, Display terminals for AV application products, and High Definition TV (HDTV).

Features

- RoHS compliance (Pb-free)
- High contrast ratio, high aperture ratio, fast response time
- PVA mode
- Wide viewing angle ($\pm 89^\circ$)
- WXGA (1366 x 768 pixels) resolution (16:9)
- Low Power consumption
- WLED (White Light Emitting Diode) Backlight
- LVDS (Low Voltage Differential Signaling) interface

General Information

Items	Specification	Unit	Note
Module Size	727.6(H _{TYP}) x 424.0(V _{TYP})	mm	±1.0mm
	24.8(D _{MAX})		
Weight	5500(Max)	g	
Pixel Pitch	0.51075(H) × 0.17025 (V) * 3	mm	
Active Display Area	697.6845(H) x 392.256(V)	mm	
Surface Treatment	Haze 0.8%, Hard-coating (2H)		
Display Colors	8 bit- 16.7M	colors	
Number of Pixels	1366 x 768	pixel	
Pixel Arrangement	RGB Horizontal stripe		
Display Mode	Normally Black		
Luminance of White	430	cd/m ²	Typ.

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1. Absolute Maximum Ratings

1-1 Operating Condition

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	13	V	(1)
Module Storage Temperature	T_{STG}	-20	60	°C	(2)
Operating Temperature	T_{OPR}	0	50	°C	(2)
Panel surface Temperature	T_{SUR}	0	60	°C	(3)
Shock (non – operating)	S_{NOP}	-	50	G	(4)
Vibration (non – operating)	V_{NOP}	-	1.5	G	(5)

Note (1) $T_a = 25 \pm 2$ °C

(2) Temperature and relative humidity range are shown in the figure below.

a. 93.8 % RH Max. ($T_a \leq 40$ °C)

b. Maximum wet-bulb temperature at 40 °C or less. ($T_a \leq 40$ °C)

c. No condensation

(3) Polarizer will not be damaged in this range, even though abnormal visual problems occur in T_{SUR} range.

(4) 11ms, sine wave, one time for $\pm X$, $\pm Y$, $\pm Z$ axis

(5) 10-300 Hz, Sweep rate 10min, 30min for X, Y, Z axis

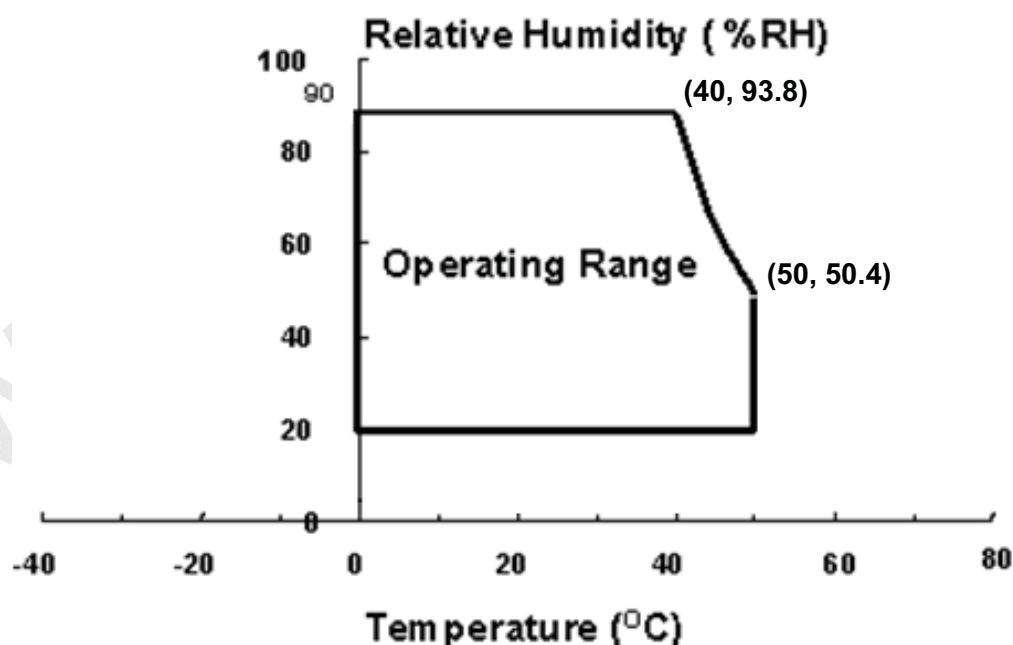


Fig. Temperature and Relative humidity range

2. Optical Characteristics

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

Measuring equipment : TOPCON BM-7,SPECTRORADIOMETER SR-3

(LED Input Current = 110mA, Ta = 25 ± 2 °C, VDD=12V, fv= 60Hz, f_{DCLK}=148.5MHz, Dim = 100%)

Item		Symbol	Condition	Min.	Typ.	Max.	Unit	Note
Contrast Ratio (Center of screen)		C/R	Normal $\theta_{L,R}=0$ $\theta_{U,D}=0$ Viewing Angle	*3000	5000	-		(3) SR-3A
Response Time	G-to-G [AVE]	Tg		-	8	18	msec	(5) RD-80S
Luminance of White (Center of screen)		Y _L		360	430	-	cd/m ²	(6) SR-3A
Color Chromaticity (CIE 1931)	Red	Rx		TYP. -0.03	TYP. +0.03	0.645	(7),(8) SR-3A	
		Ry	0.331					
	Green	Gx	0.315					
		Gy	0.616					
	Blue	Bx	0.156					
		By	0.048					
	White	Wx	0.280					
		Wy	0.285					
Color Gamut		-	-	70	-	%	(7) SR-3A	
Color Temperature		-	-	10000	-	K	(9)	
Viewing Angle	Hor.	θ_L	C/R≥10	79	89	-	Degree	(8) EZ-Contrast
		θ_R						
	Ver.	θ_U						
		θ_D						
Brightness Uniformity (9 Points)		B _{uni}	-	-	30	%	(4) SR-3	

* CR = (White at point ⑤ of Note 2) / (Most Dark Point of Black Pattern at area ① of Note 2)

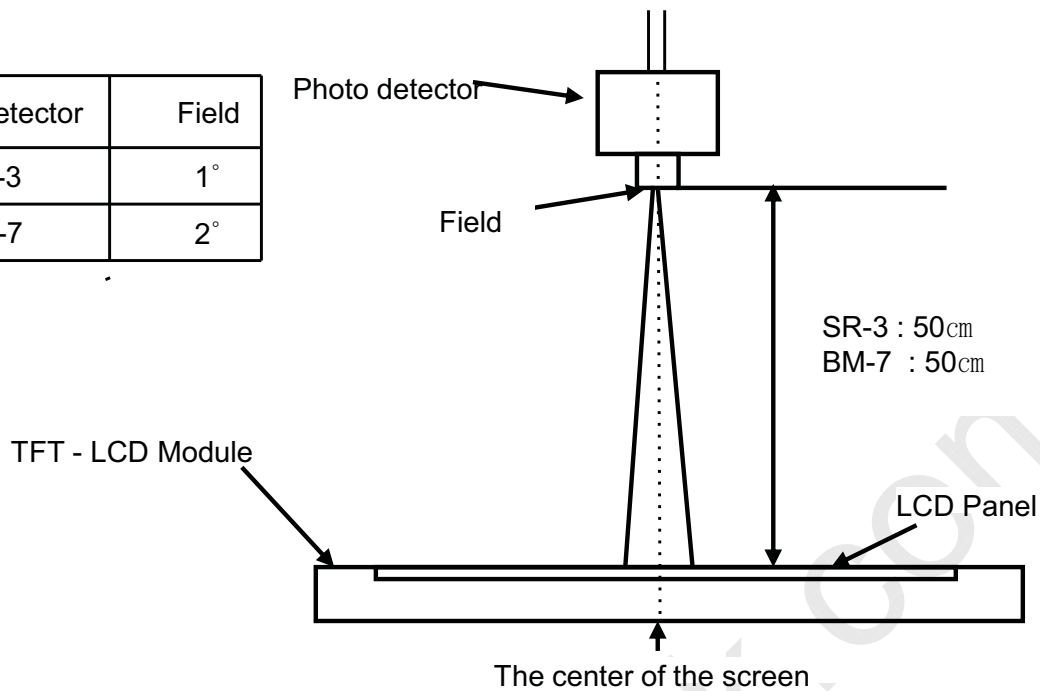
Note (1) Test Equipment Setup

The measurement should be executed in a stable, windless and dark room between 40min and 60min after lighting the back light at the given temperature for stabilization of the back light. This should be measured in the center of screen.

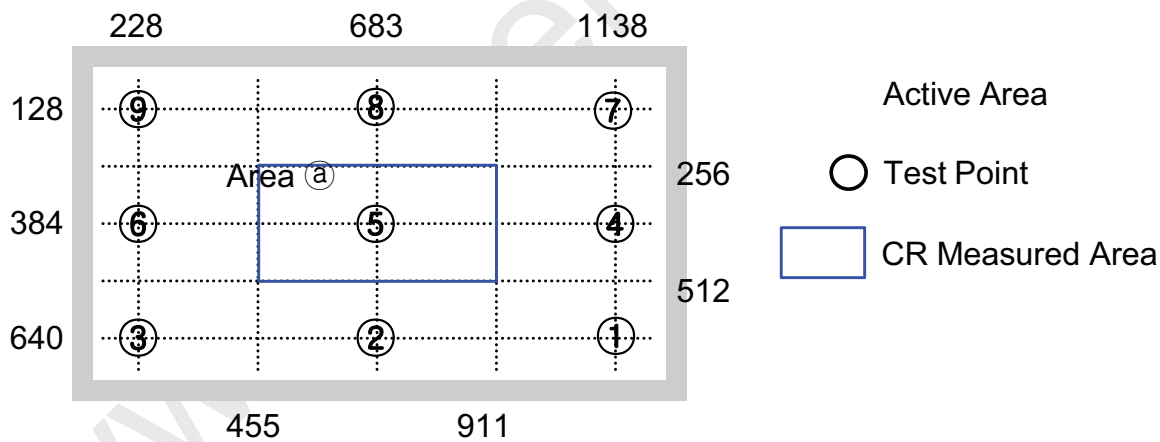
Single lamp current @ Vdim = 100%
Environment condition : Ta = 25 ± 2 °C

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Photo detector	Field
SR-3	1°
BM-7	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 point ⑤ of the panel

$$C/R = \frac{G_{max}}{G_{min}}$$

Gmax : Luminance with all pixels white

Gmin : Luminance with all pixels black

Note (4) Definition of 9 points brightness uniformity

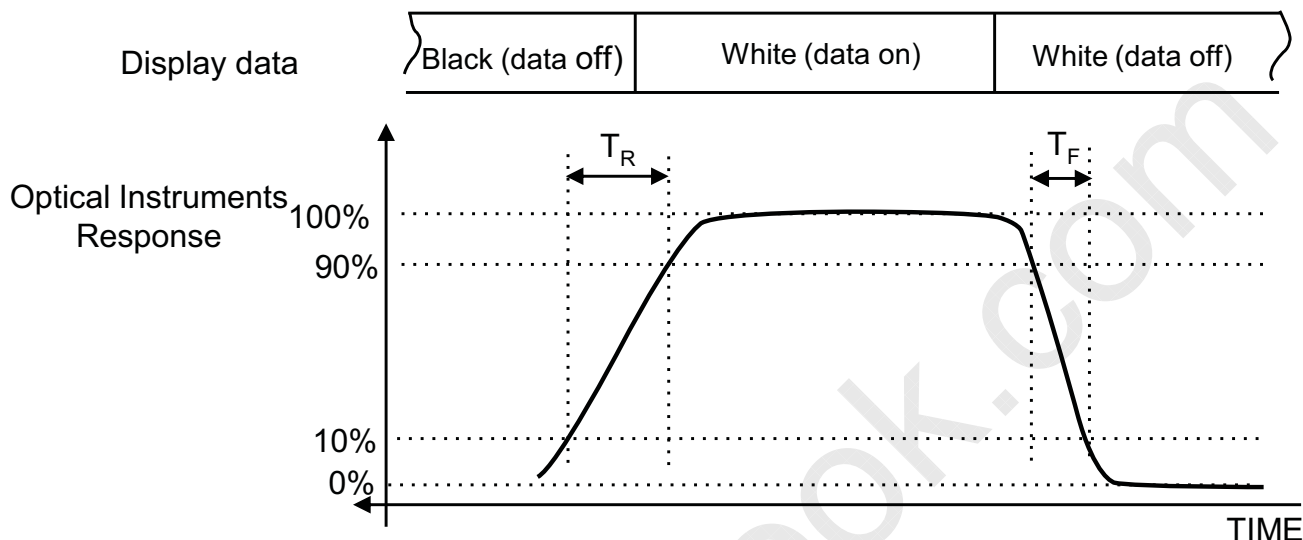
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$$B_{uni} = 100 * \frac{(B_{max} - B_{min})}{B_{max}}$$

B_{max} : Maximum brightness

B_{min} : Minimum brightness

Note (5) Definition of Response time : Sum of Tr, Tf



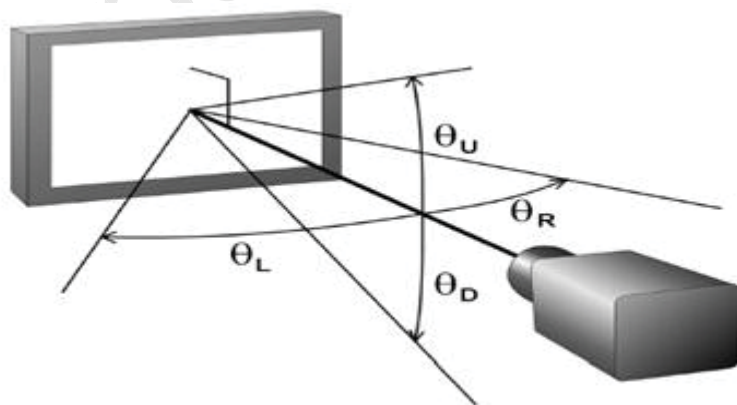
Note (6) Definition of Luminance of White : Luminance of white at center point ⑤

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

Color coordinate of Red, Green, Blue & White at center point ⑤

Note (8) Definition of Viewing Angle

: Viewing angle range (C/R ≥ 10)



Note (9) Definition of 2 point Gamma

$$\text{Gamma} = \log(X_{lum}/100) / \log(Y/100)$$

$$X_{lum} = (Z - B_{min}) / (B_{max} - B_{min}) \times 100$$

Y: Measurement Level / Z: Measurement Brightness

B_{max}: Maximum Brightness / B_{min}: Minimum Brightness

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3. Electrical Characteristics

3.1 TFT LCD Module

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

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

Item	Symbol	Min.	Typ.	Max.	Unit	Note
Voltage of Power Supply	V_{DD}	11	12	13	V	(1)
Current of Power Supply	(a) Black	-	375	-	mA	(2),(3)
	(b) White	-	350	450		
	(c) Mosaic	-	365	-		
	(4) Max Pattern	-	670	770		
Vsync Frequency	f_V	47	60	63	Hz	
Hsync Frequency	f_H	45	48.6	53	kHz	
Main Frequency	f_{DCLK}	65	80	86	MHz	
Rush Current	I_{RUSH}	-	-	3	A	(4)

Note (1) The ripple voltage should be controlled under 10% of V_{DD} .

(2) $f_V=60\text{Hz}$, $f_{DCLK} = 148.5\text{MHz}$, $V_{DD} = 12.0\text{V}$, DC Current.

(3) Power dissipation check pattern (LCD Module only)

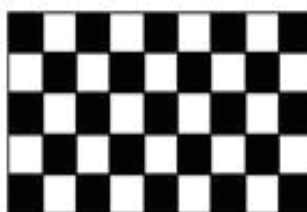
a) Black Pattern



b) White Pattern



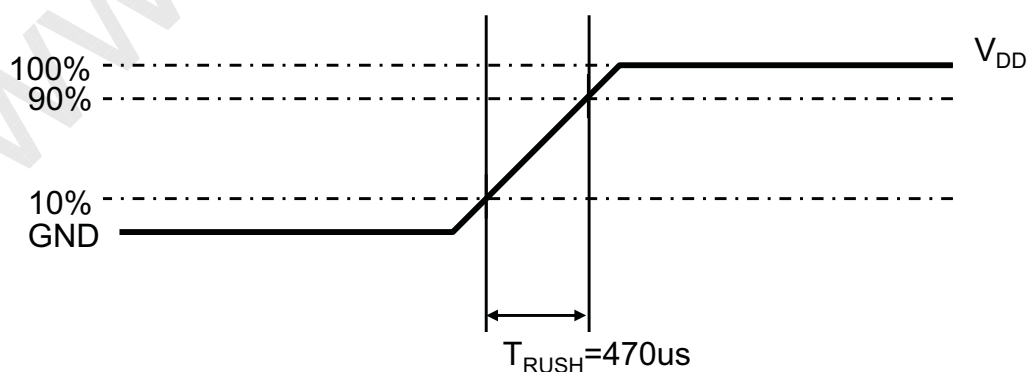
c) Mosaic



d) Max. Pattern



(4) Measurement Conditions



Rush Current I_{RUSH} can be measured when T_{RUSH} is 1ms

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3.2 Back Light Unit

The back light contains 60 LEDs.

The characteristics of lamps are shown in the following tables.

Ta=25 ± 2°C

Item		Symbol	Min.	Typ.	Max.	Unit	Note
Operating Life Time		Hr	30,000	-	-	Hour	(1)
Operating Current	Continuous	I _{op}	-	110	200	mA	@140mA / 30LEDs @T _j 25°C
Operating Voltage	Continuous	V _{op}	171	-	194	V	@110mA / 30LEDs @T _j 25°C
Range of Voltage		ΔV _f	-	-	11.5	V	@140mA / 30LEDs @T _j 25°C

Note (1) It is defined as the time to take until the brightness reduces to 50% of its original value at each String, I_{op}=110.0mA

[Definition of Operating Voltage : At each Strings, I_{op} = 140.0 mA (typ.)]

3.2.1 Review and Update for Electrical Specification

According to the improvement of efficiency for devices, the electrical specification would be reviewed and revised after initial values had been established. This revision mentioned above should be discussed at appropriate time.

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5. Input Terminal Pin Assignment

5.1. Input Signal & Power of Control Board

Connector : 196260-30041 (P-TWO Industries)

PIN No.	Signal	Description	PIN No.	Signal	Description
1	N.C.	No Connection	16	GND	GND
2	SCL_I	I2C Clock	17	LV3_NI	Even LVDS Signal -
3	SDA_I	I2C Data	18	LV3_PI	Even LVDS Signal +
4	GND	GND	19	GND	GND
5	LV0_NI	LVDS Signal -	20	N.C.	No Connection
6	LV0_PI	LVDS Signal +	21	LVDS_SEL	LVDS Selection
7	GND	GND	22	WPN	Bus Release
8	LV1_NI	LVDS Signal -	23	GND	GND
9	LV1_PI	LVDS Signal +	24	GND	GND
10	GND	GND	25	N.C.	No Connection
11	LV2_NI	LVDS Signal -	26	Power	V _{DD}
12	LV2_PI	LVDS Signal +	27	Power	V _{DD}
13	GND	GND	28	Power	V _{DD}
14	LVCLK_NI	LVDS Clock -	29	Power	V _{DD}
15	LVCLK_PI	LVDS Clock +	30	Power	V _{DD}

■ Option Pin Description

These pins are CMOS interface.

Please use within the range of the following restriction.

VIH : 2.4V(min) / 3.5V(max)

VIL : 0.0V(min) / 0.4V(max)

■SCL : Pull up 22Ω/ 4.7kΩ

■SDA : Pull up 22Ω/ 4.7kΩ

Note(1) Pin number starts from Right side

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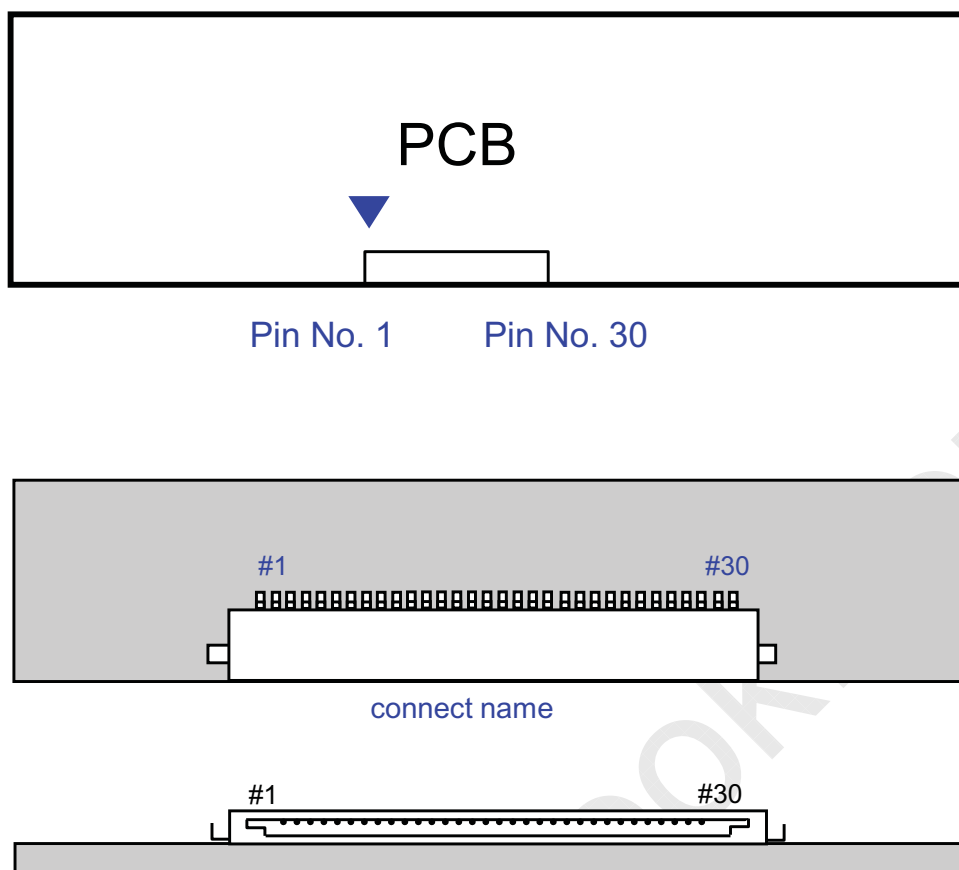


Fig. Connector diagram

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

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5.2. LS Bar Input Pin Configuration

1. CONNECTOR : Morex/51103-040

Pin	Pin Configuration (Function)
1	DC Voltage (+)
2	N.C.
3	N.C.
4	DC Voltage (+)

2. CONNECTOR : Morex/51103-0500

Pin	Pin Configuration (Function)
1	Feedback
2	N.C.
3	N.C.
4	Feedback
5	N.C.

5.3 LVDS Interface

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	LVDS pin	JEIDA - Data	Normal Data
TxOUT/RxIN0	TxIN/RxOUT0	R2	R0
	TxIN/RxOUT1	R3	R1
	TxIN/RxOUT2	R4	R2
	TxIN/RxOUT3	R5	R3
	TxIN/RxOUT4	R6	R4
	TxIN/RxOUT6	R7	R5
	TxIN/RxOUT7	G2	G0
TxOUT/RxIN1	TxIN/RxOUT8	G3	G1
	TxIN/RxOUT9	G4	G2
	TxIN/RxOUT12	G5	G3
	TxIN/RxOUT13	G6	G4
	TxIN/RxOUT14	G7	G5
	TxIN/RxOUT15	B2	B0
	TxIN/RxOUT18	B3	B1
TxOUT/RxIN2	TxIN/RxOUT19	B4	B2
	TxIN/RxOUT20	B5	B3
	TxIN/RxOUT21	B6	B4
	TxIN/RxOUT22	B7	B5
	TxIN/RxOUT24	HSYNC	HSYNC
	TxIN/RxOUT25	VSYNC	VSYNC
	TxIN/RxOUT26	DEN	DEN
TxOUT/RxIN3	TxIN/RxOUT27	R0	R6
	TxIN/RxOUT5	R1	R7
	TxIN/RxOUT10	G0	G6
	TxIN/RxOUT11	G1	G7
	TxIN/RxOUT16	B0	B6
	TxIN/RxOUT17	B1	B7
	TxIN/RxOUT23	RESERVED	RESERVED



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

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COLOR	DISPLAY (10bit)	DATA SIGNAL																												GRAY SCALE LEVEL	
		RED										GREEN										BLUE									
		R0	R1	R2	R3	R4	R5	R6	R7	R8	R9	G0	G1	G2	G3	G4	G5	G6	G7	G8	G9	B0	B1	B2	B3	B4	B5	B6	B7		B8
BASIC COLOR	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	0	0	0	0	-	
	BLUE	0	0	0	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	1	-
	GREEN	0	0	0	0	0	0	0	0	0	0	1	1	1	1	1	1	1	1	1	1	0	0	0	0	0	0	0	0	0	-
	CYAN	0	0	0	0	0	0	0	0	0	0	1	1	1	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	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	-
	MAGENTA	1	1	1	1	1	1	1	1	1	1	0	0	0	0	0	0	0	0	0	0	1	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	1	1	1	1	0	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	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	0	0	0	0	R0	
	DARK ↑	1	0	0	0	0	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	0	0	0	0	R2	
		:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	R3~R1020
		:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	
	LIGHT ↓	1	0	1	1	1	1	1	1	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	R1021	
		0	1	1	1	1	1	1	1	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	R1022	
RED	1	1	1	1	1	1	1	1	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	R1023		
GRAY SCALE OF GREEN	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	0	0	0	0	G0	
	DARK ↑	0	0	0	0	0	0	0	0	0	0	1	0	0	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	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	G2	
		:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	G3~G1020	
		:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:		
	LIGHT ↓	0	0	0	0	0	0	0	0	0	0	1	0	1	1	1	1	1	1	1	1	0	0	0	0	0	0	0	0	G1021	
		0	0	0	0	0	0	0	0	0	0	0	1	1	1	1	1	1	1	1	1	0	0	0	0	0	0	0	0	G1022	
GREEN	0	0	0	0	0	0	0	0	0	0	1	1	1	1	1	1	1	1	1	1	0	0	0	0	0	0	0	0	G1023		
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	0	0	0	0	B0	
	DARK ↑	0	0	0	0	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	0	0	0	0	1	0	0	0	0	0	0	B2	
		:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	B3~B1020	
		:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:		
	LIGHT ↓	0	0	0	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	B1021	
		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1	1	1	1	1	1	B1022	
BLUE	0	0	0	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	B1023		

Note) 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

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7. Interface Timing

7.1 Timing Parameters (DE mode)

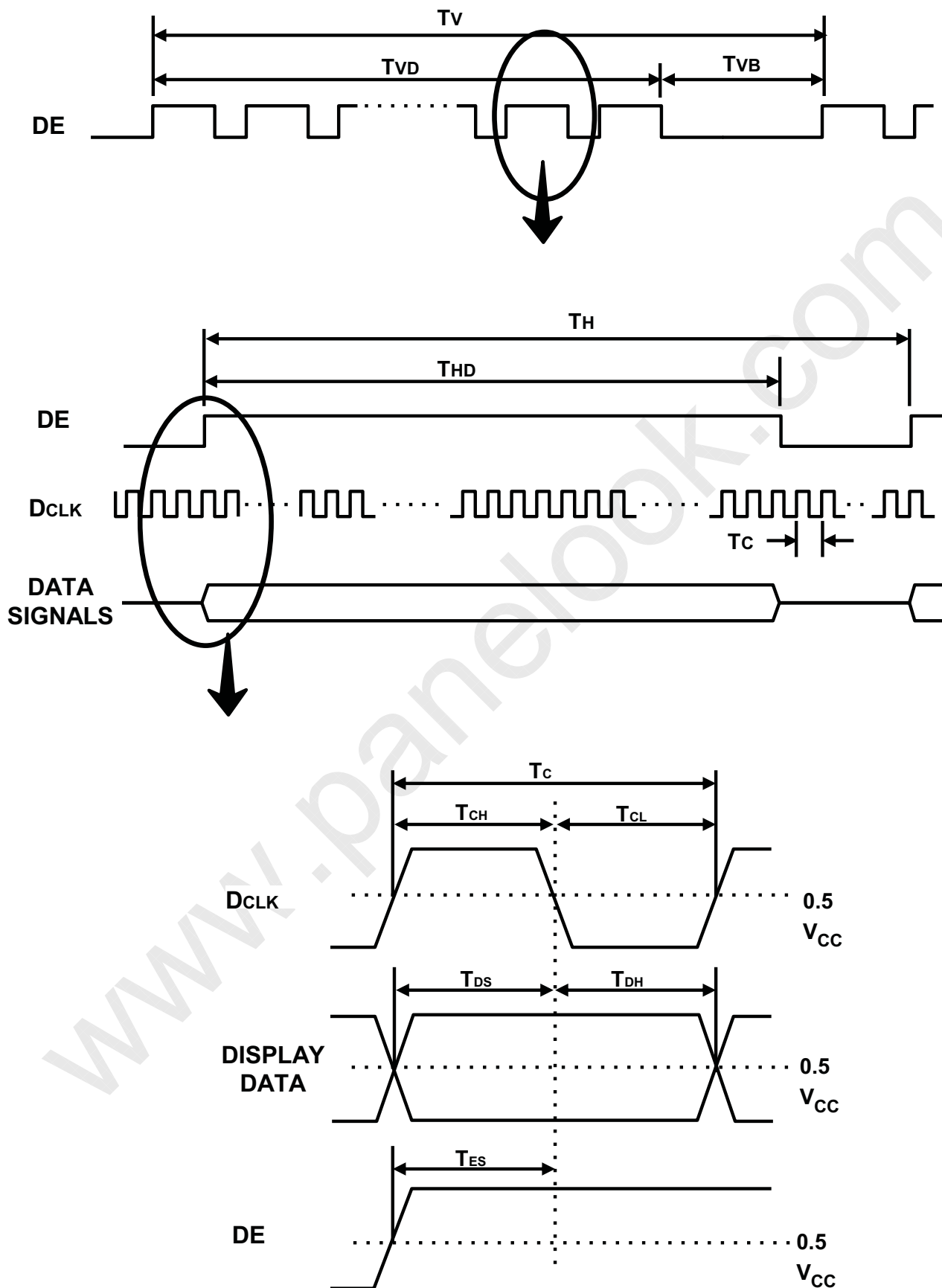
SIGNAL	ITEM	SYMBOL	MIN.	TYP.	MAX.	Unit	NOTE
Clock	Frequency	$1/T_C$	65	80	86	MHz	-
Hsync		F_H	45	48.6	53	KHz	-
Vsync		F_V	47	60	63	Hz	-
Vertical Display Term	Active Display Period	T_{VD}	768	768	768	lines	-
	Vertical Total	T_{VB}	775	810	1300	Lines	-
Horizontal Display Term	Active Display Period	T_{HD}	1366	1366	1366	clocks	-
	Horizontal Total	T_H	1450	1648	2000	clocks	-

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

- (1) Test Point : TTL control signal and CLK at LVDS Tx input terminal in system
- (2) Internal $V_{DD} = 3.3V$

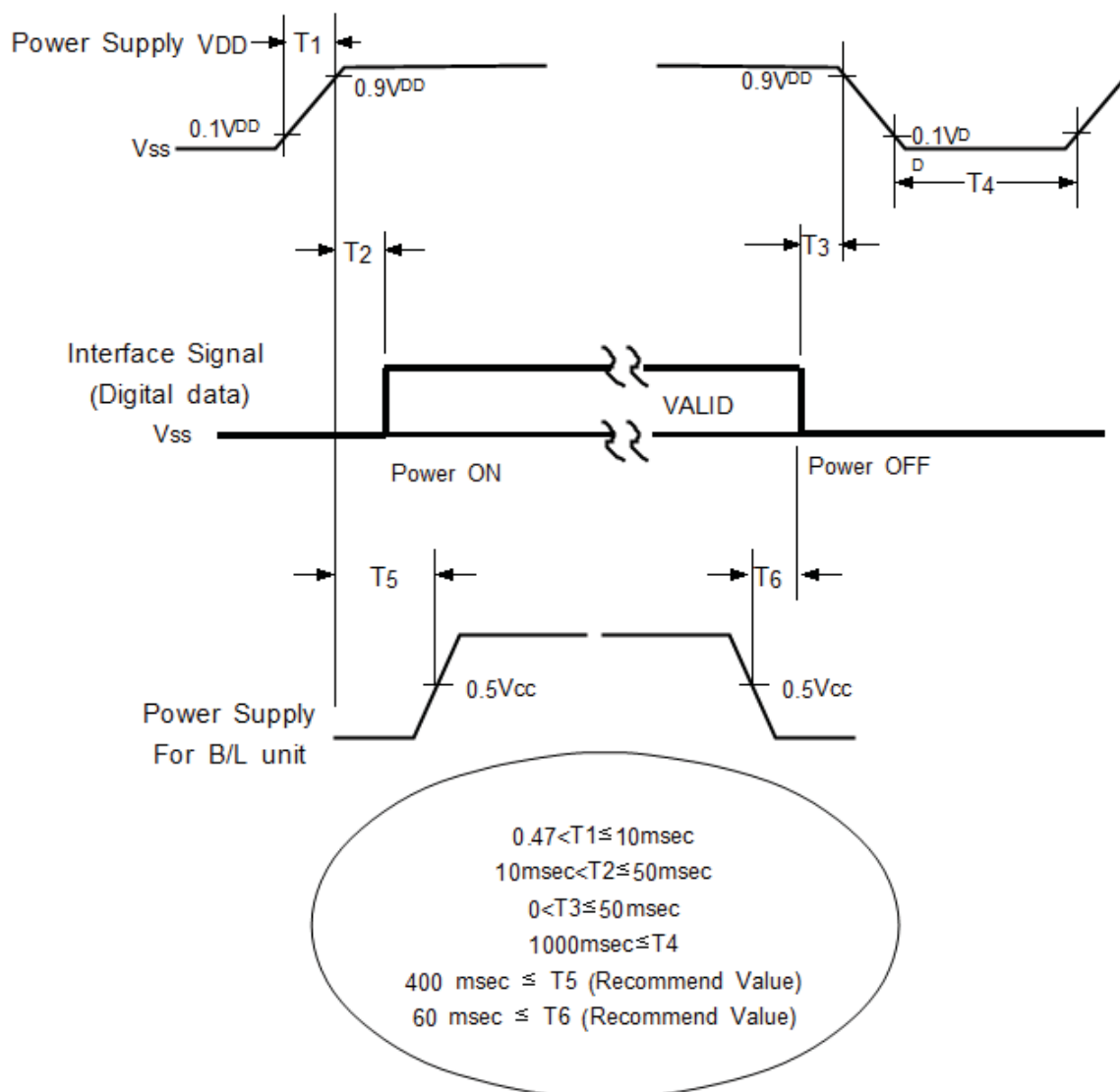
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7.2 Timing diagrams of interface signal (DE mode)



7.3 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.



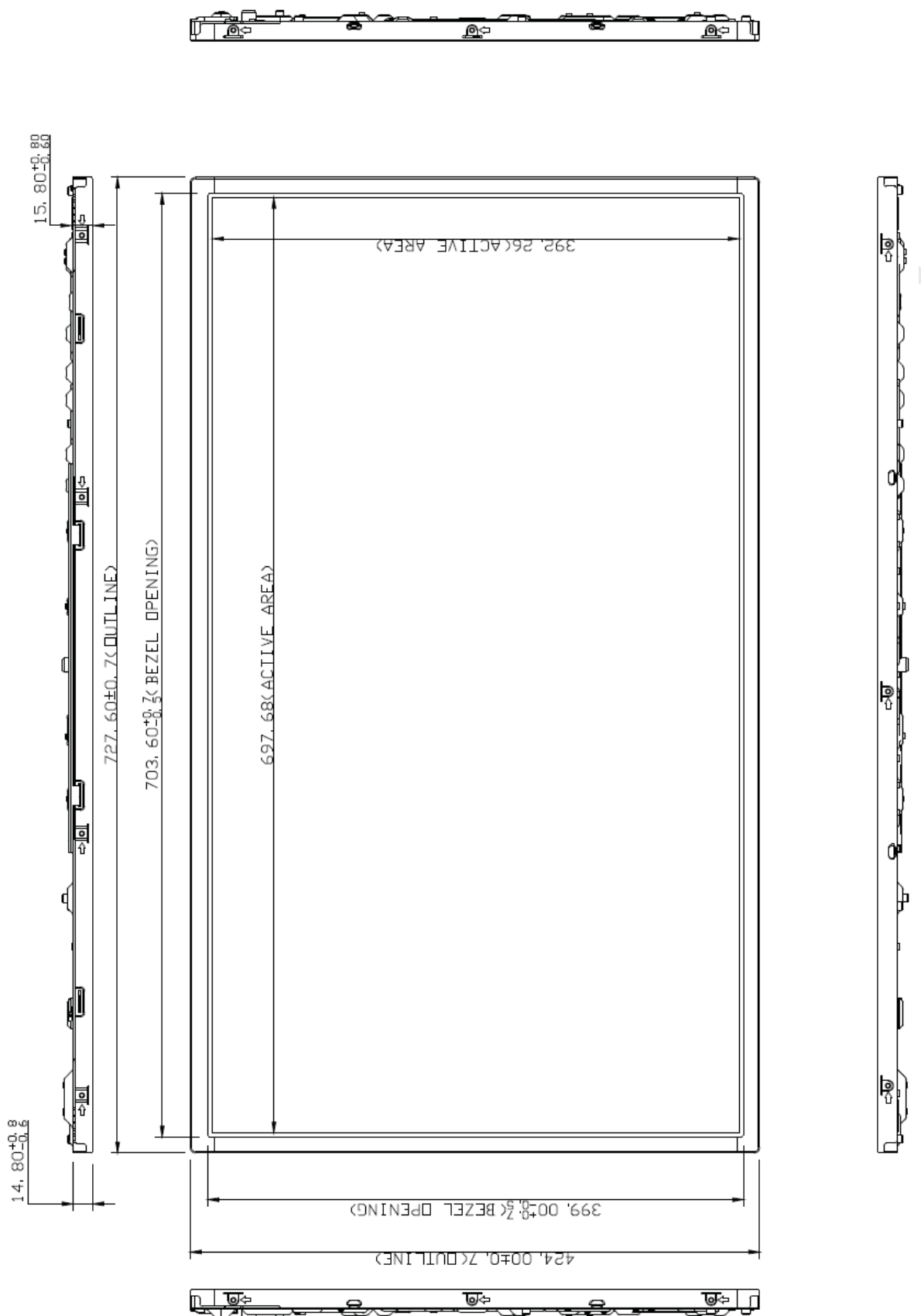
- The supply voltage of the external system for the Module input should be the same as the definition of V_{DD}.
- Apply the lamp voltage within the LCD operation range. When the back light turns on before the LCD operation or the LCD turns off before the back light turns off, the display may momentarily show abnormal screen.
- In case of V_{DD} = off level, please keep the level of input signals low or keep a high impedance.
- T4 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.

8.1 Outline Dimension

a. Front View

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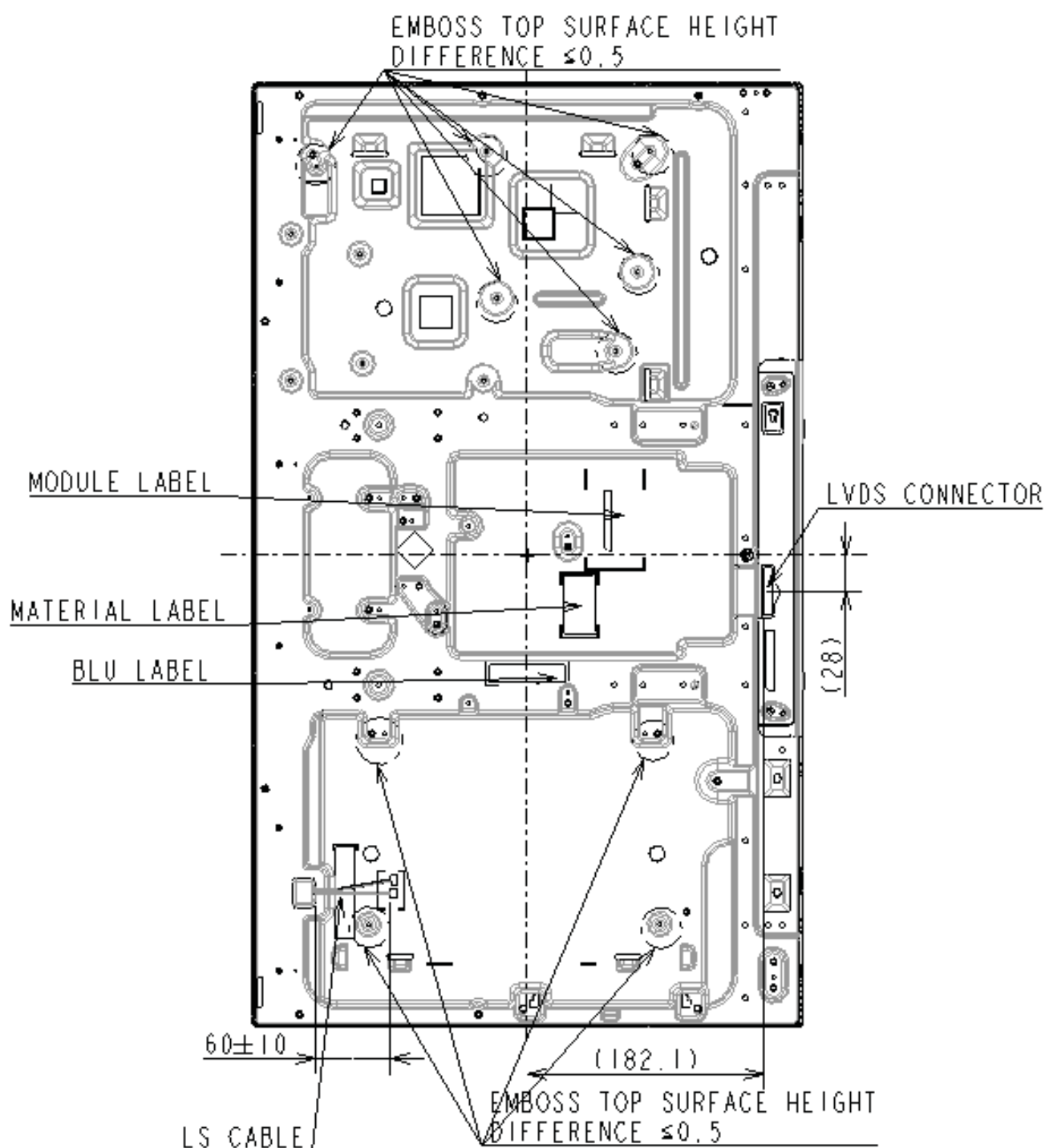
[WARP SPEC ± 1.5]



8.1 Outline Dimension

b. Rear View

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*TAPE TO HOLD LS CABLE SHALL BE FOLDED TO ENABLE TAPE TO BE REMOVED EASILY.

12. PACKING

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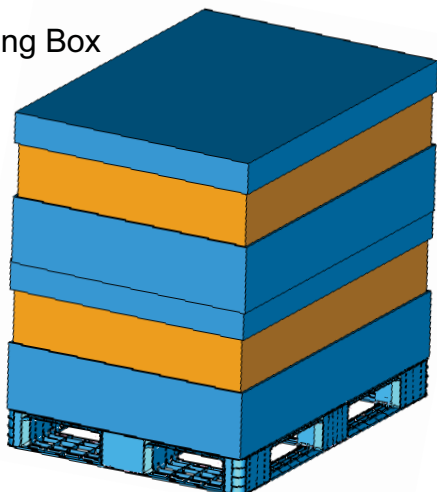
12.1 CARTON (Internal Package)

(1) Packing Form

Corrugated fiberboard box and corrugated cardboard as shock absorber

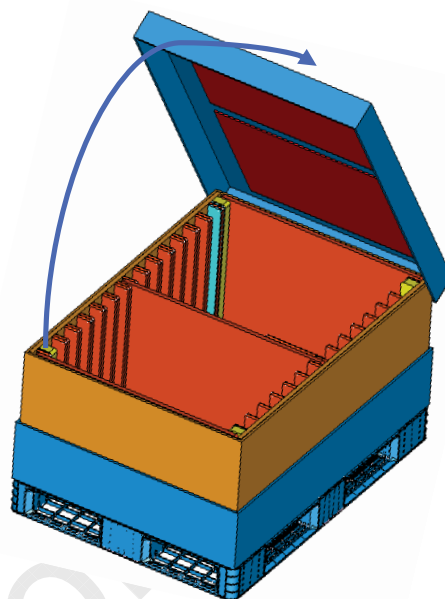
(2) Packing Method

Packing Box



Module(52EA)

Pallet



→ Direction be able to Open

12.2 Packing Specification

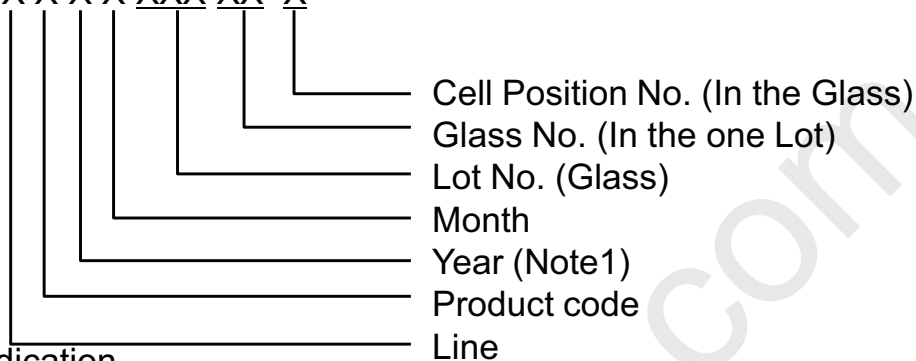
Item	Specification	Remark
LCD Packing	26ea / (Packing Box)	1. 260kg/LCD(52ea) 2. 30kg/Packing Box(2set) 3. Packing Box Material : Paper
Desiccant (Drier)	4ea / LCD	10g/ea, Cobalt-dichloride-free
Pallet	2Box / Pallet	Pallet weight : 5.3kg
Packing Direction	Vertical	-
Total Pallet Size	L x W x Height	1150mm x 850mm x 1085mm
Total Pallet Weight	297kg	Pallet(5.3kg) + Module(52 x 5kg = 260kg) + Packing BOX(15 x 2 = 30kg) + Desiccant(0.03kg x 52 = 1.56kg)
Stack Layer	3 layer in warehouse. 2 layer in container.	
Shielding Bag	Compound PE / Sealing / 70 μ m	Material / Adhesive tape / Thickness
POL Protection Film	PET / 0.125mm	Material / Thickness

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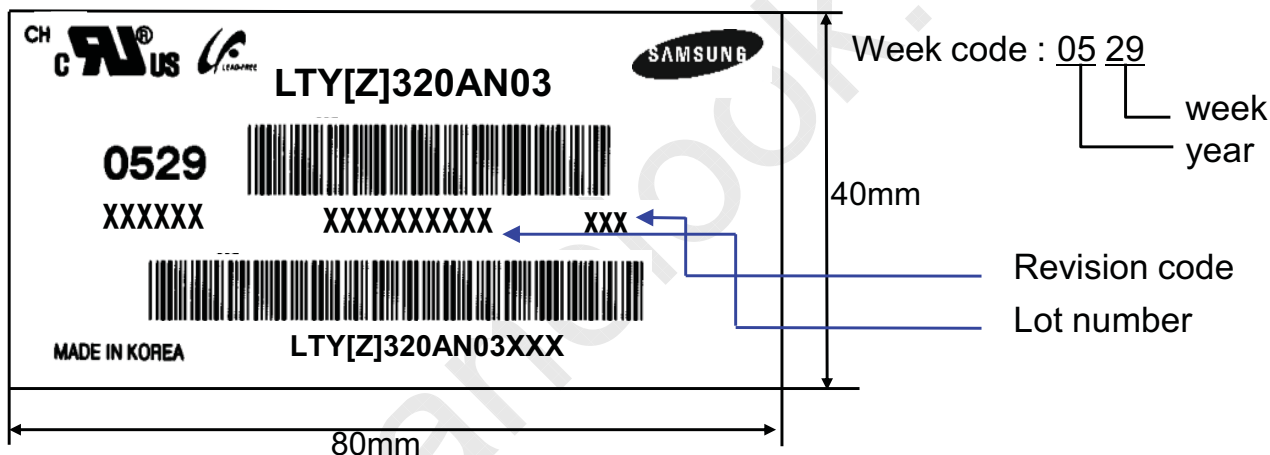
13. MARKING & OTHERS

A nameplate bearing followed by is affixed to a shipped product at the specified location on each product.

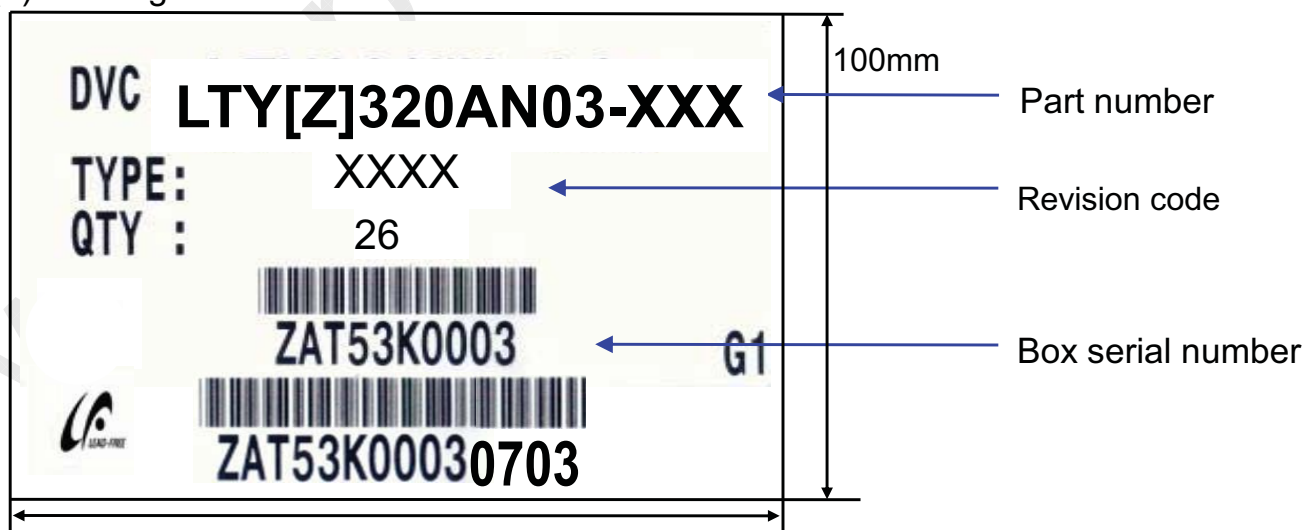
- (1) Parts number : LTY[Z]320AN03-XXX
- (2) Revision: One letters
- (3) Lot number : X X X X XXX XX X



(4) Nameplate Indication



(5) Packing box attach



(6) Others

- 1. After service part
 Lamps cannot be replaced because of the narrow bezel structure.

14. General Precautions

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14.1 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 use high voltage, it should be disconnected from power before it is assembled or disassembled.
- (c) 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 back light.
- (d) Note that polarizers are very fragile and could be damage 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 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 LED FFC.
- (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.

14.2 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 should be stored in a dark place. It is prohibited to apply sunlight or fluorescent light in storing.
- (d) Storage period is recommended not to exceed 1 year.

14.3 Operation

- (a) No Connection or disconnect the Module in the "Power On" condition.
- (b) Power supply should always be turned on/off by the "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.
- (d) The cable between the back light connector and its Converter power supply should be connected directly with a minimized length. A longer cable between the back light and the inverter may cause lower luminance of LED and may require higher startup voltage(Vs).

14.4 Operation Condition Guide

- (a) The LCD product should be operated under normal conditions.
Normal condition is defined as below;
 - Temperature : 20 ± 15 °C
 - Humidity : 55 ± 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.

14.5 Others

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- (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 "sticked" 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.