



ELECTRONICS

Approval

T
D

SAMSUNG TFT-LCD

MODEL NO. :



Customer Approval

Any Modification of Spec is not allowed without SEC's permission.

Approved by : **S.C. OH**

Mobile Display Business Team
LCD Business
Samsung Electronics Co., LTD.



Revision History

Date	Rev. No.	Page	Summary
Mar. 6.2007	000		Rev.000 was first issues.

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General Description

* Description

██████████ is a TMR(Transmissive with Micro Reflective) type color active matrix TFT (Thin Film Transistor) liquid crystal display (LCD) that uses amorphous silicon TFT as a switching devices. This model is composed of a TFT-LCD module, a driver circuit and a back-light unit.

The resolution of a 4.3" contains 480x272(RGB) dots and can display up to 16.7M colors.

* Features

- triple-gate & Dual ASG
- Transmissive with Micro Reflective type and back-light with 10 LEDs are available.
- PVA(Patterned Vertical Alignment) mode.
- Dot inversion mode.
- 24bit RGB Interface
- DE(Data Enable) & SYNC mode - DE, Vsync, Hsync, DOTCLK

* Applications

- Display terminals for PMP(Portable Multimedia Player) , Portable CNS(P-CNS) , MP3 application products.
- Display terminals for AV application products.

* General information

Items	Specification	Unit	Note
Display area	95.04(H) X 53.856(V) (4.3" diagonal)	mm	-
Driver element	a-Si TFT active matrix	-	-
Display colors	16,777,216	colors	-
Number of dots	480(H) x 272 x RGB(V)	dot	-
Pixel arrangement	RGB stripe	-	-
Pixel pitch	0.198(H) X 0.198(V)	mm	128ppi
Display mode	Normally Black	-	-

* Mechanical information

Item		Min.	Typ.	Max.	Unit	Note
Module size	Horizontal(H)	105.3	105.5	105.7	mm	-
	Vertical(V)	67.0	67.2	67.4	mm	(1)
	Depth(D)	3.85	4.05	4.25	mm	(1)
Weight		-	60	65	g	(2)

Note (1) Not include FPC.

Refer to the Outline Dimension in the "9. Outline Dimension" for further information.

(2) Module and Back-light unit are included.

1. Absolute Maximum Ratings

1.1 Absolute Ratings Of Environment

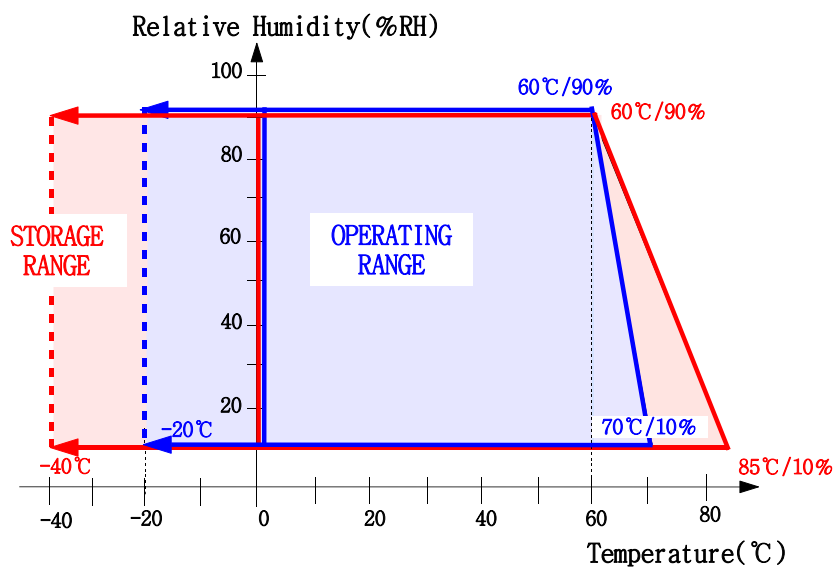
ITEM	MIN	MAX	REMARK
Storage Temperature	-40°C	85°C	Note(1)
Operating Temperature	-20°C	70°C	Note(2)(3)

Note(1) 90%RH maximum humidity, 60°C maximum wet-bulb temperature

(2) When operated at a temperature lower than 0°C, the LCD worked slowly and the screen appeared low-contrast images due to the characteristics of LC(Liquid Crystal).

(3) If any fixed pattern is displayed on LCD for Reliability test, image-sticking phenomenon may occur.

(Please refer image-sticking reliability test in Page 32.)



Temperature & Humidity Graph at Absolute Environment

1.2 Electrical Absolute Ratings

(1) TFT-LCD Module

(Ta = 25 ± 2°C, VSS=GND=0)

Item	Symbol	Min.	Max.	Unit	Note
Input voltage	VDD	-0.3	4.6	V	-

(2) Back-Light Unit

(Ta = 25 ± 2°C)

Item	Symbol	Min.	Max.	Unit.	Note
Current	I _B	-	25	mA	(1)

Note (1) Permanent damage to the device may occur if maximum values are exceeded or reverse voltage is loaded.

Functional operation should be restricted to the conditions described under normal operating conditions.

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 (1).

Measuring equipment: SR3, BM-7, EZ-Contrast

(Ta=25 ± 2°C , VDD=2.5V or 3.3V , fv=60Hz , fDCLK=9.2MHz , IL=22mA)

Item	Symbol	Condition	Min.	Typ.	Max.	Unit	Note	
Contrast ratio (Center point)	C/R		400	800	-	-	(2) SR3	
Luminance of white (Center point)	Y _L	NOTE (1)	300	400	-	cd/m ²	(3) SR3	
Response time	Rising	T _R	-	17	22	msec	(4) BM-7	
	Falling	T _F	-	15	20			
Color chromaticity (CIE 1931)	White	W _X	Normal Viewing Angle B/L On	0.27	0.32	0.37	-	(5) SR3
		W _Y		0.29	0.34	0.39		
	Red	R _X		0.55	0.60	0.65		
		R _Y		0.31	0.36	0.41		
	Green	G _X		0.32	0.37	0.42		
		G _Y		0.52	0.57	0.62		
	Blue	B _X		0.10	0.15	0.20		
		B _Y		0.07	0.12	0.17		
Viewing angle	Hor.	Θ _L	C/R ≥ 10 B/L On	70	80	-	Degrees	(6) EZ-Contrast
		Θ _R		70	80	-		
	Ver.	Φ _H		70	80	-		
		Φ _L		70	80	-		

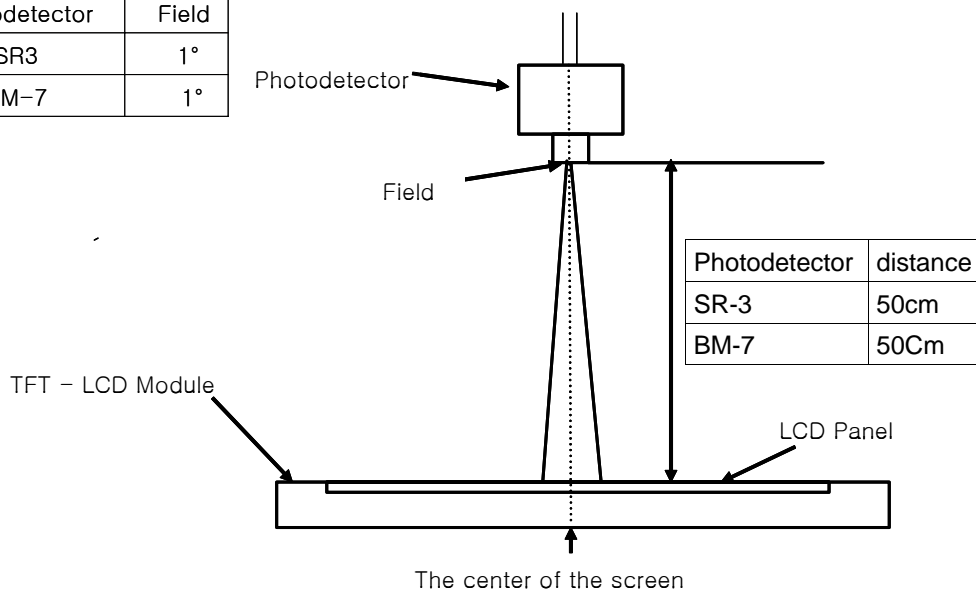
Note (1) Test Equipment Setup

After stabilizing and leaving the panel alone at a given temperature for 10 min , the measurement should be executed. Measurement should be executed in a stable, windless, and dark room. 10 min after lighting the back-light. This should be measured in the center of screen.

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

Back-Light On condition

Photodetector	Field
SR3	1°
BM-7	1°



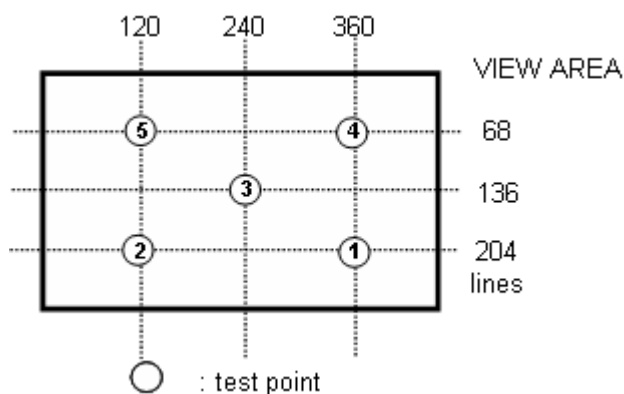
Note (2) Definition of Contrast Ratio (C/R) : Ratio of gray max (Gmax) & gray min (Gmin) at the center point

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

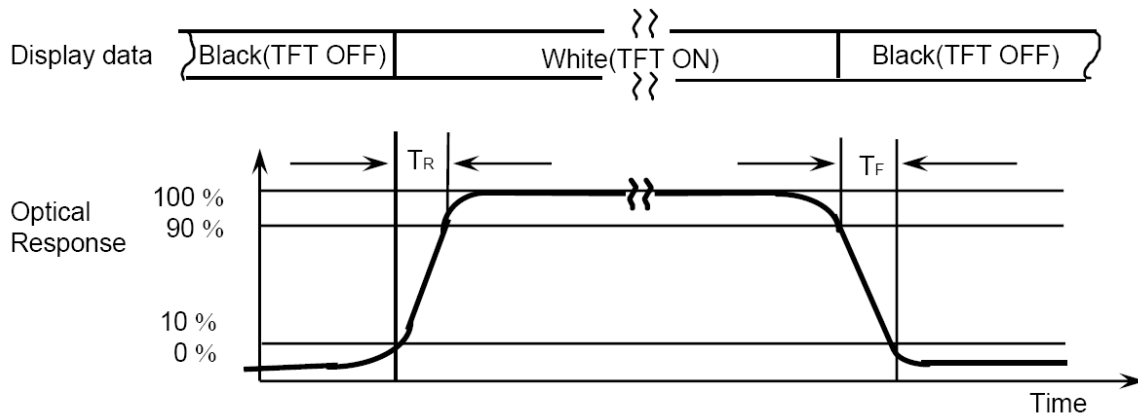
* Gmax : Luminance with all pixels white

* Gmin : Luminance with all pixels black

Note (3) Definition of Luminance of White : Luminance of white at the center point (@③)



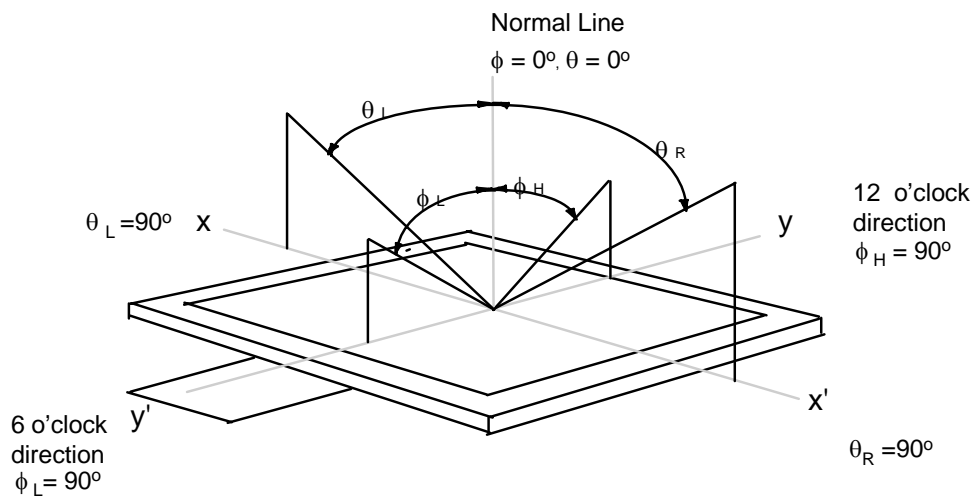
Note (4) Definition of Response time : Sum of T_r , T_f



Note (5) Definition of Color Chromaticity (CIE 1931)

Color coordinate of white & red, green, blue at center point.

Note (6) Definition of Viewing Angle : Viewing angle range ($CR \geq 10$)



3. Electrical Characteristics

3.1 TFT-LCD Module

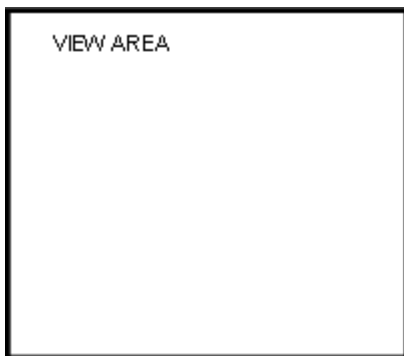
$T_a = 25 \pm 2^\circ\text{C}$

ITEM		Symbol	Min.	Typ.	Max.	Unit	Note
Logic supply voltage		VDD	2.9	3.3	3.5	V	
Vsync Frequency		f_v	-	60	70	Hz	
Hsync Frequency		f_H	-	17.26	-	kHz	
Main Frequency		f_{DCLK}	-	9.2	15.0	MHZ	
Power Dissipation	White	-	-	100	120	mW	(1),(2)
	Black		-	85	105	mW	

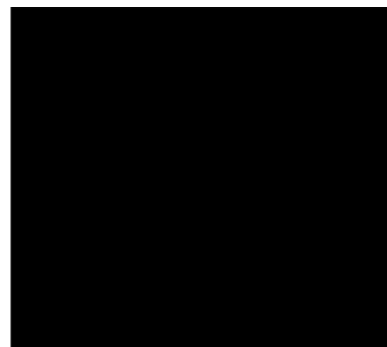
Note (1). $f_v=60\text{Hz}$, $f_{DCLK}=9.2\text{MHZ}$, $VDD= 3.3\text{V}$

Note (2). Power Dissipation check pattern

a) White Pattern



b) Black Pattern



3.2 Back-Light unit

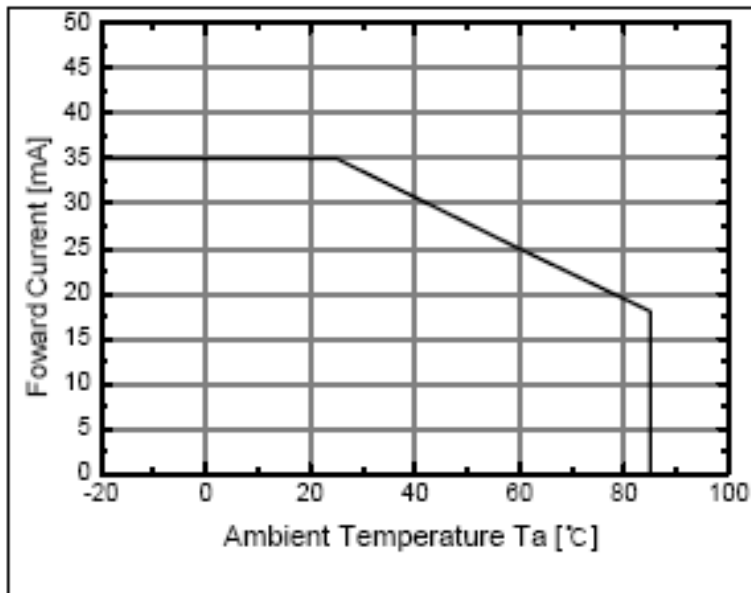
The back-light system is an edge-lighting type with 10 white LED(Light Emitting Diode)s.

(Ta=25 ± 2°C)

Item	Symbol	Min.	Typ.	Max.	Unit	Note
LEDs Current	I_B	-	22	24	mA	(1)
Power Consumption	P_{BL}	-	730	-	mW	(2)

Note (1) 10 LEDs.

(2) Where $I_B = 22 \text{ mA}$, $V_B = P_{BL} / I_B$



4. Touch Screen Panel Specifications

4.1. Electrical Characteristics

Item	Min.	Typ.	Max.	Unit	Note
Linearity	-1.5	-	1.5	%	Analog X and Y directions
Terminal resistance	200	-	900	Ω	X
	200	-	900	Ω	Y
Insulation resistance	10	-	-	M Ω	DC 25V
Voltage	-	-	7	V	DC
Chattering	-	-	10	ms	100k Ω pull-up
Transparency	-	80	-	%	JIS-K7105, ASTM D1003, @550nm

Caution (1) : Do not operate it with a thing except a polyacetal pen (tip R0.8mm or more) or a finger, especially those with hard or sharp tips such as a ball point pen or a mechanical pencil.

4.2. Mechanical & Reliability Characteristics

Item	Min.	Typ.	Max.	Unit	Note
Activation force	-		80	g	(1)
Durability (surface scratching)	Write 100,000	-	-	characters	(2)
Durability (surface pitting)	1,000,000	-	-	touches	(3)
Surface hardness	3	-	-	H	JIS K5400, ASTM D3363

Note (1) Stylus pen Input : R0.8mm polyacetal pen or Finger

(2) Measurement for Surface area

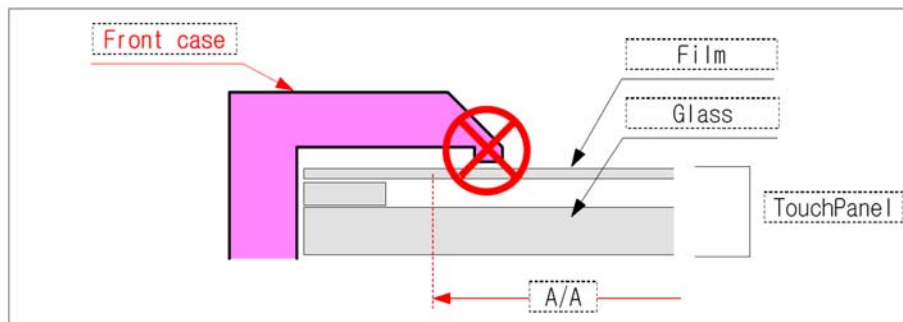
- Scratch 100,000 times straight line on the Film with a stylus change every 20,000times
- Force : 250gf
- Speed : 60mm/sec
- Stylus : R0.8 polyacetal tip

(3) Pit 1,000,000 times on the Film with a R8.0 silicon rubber.

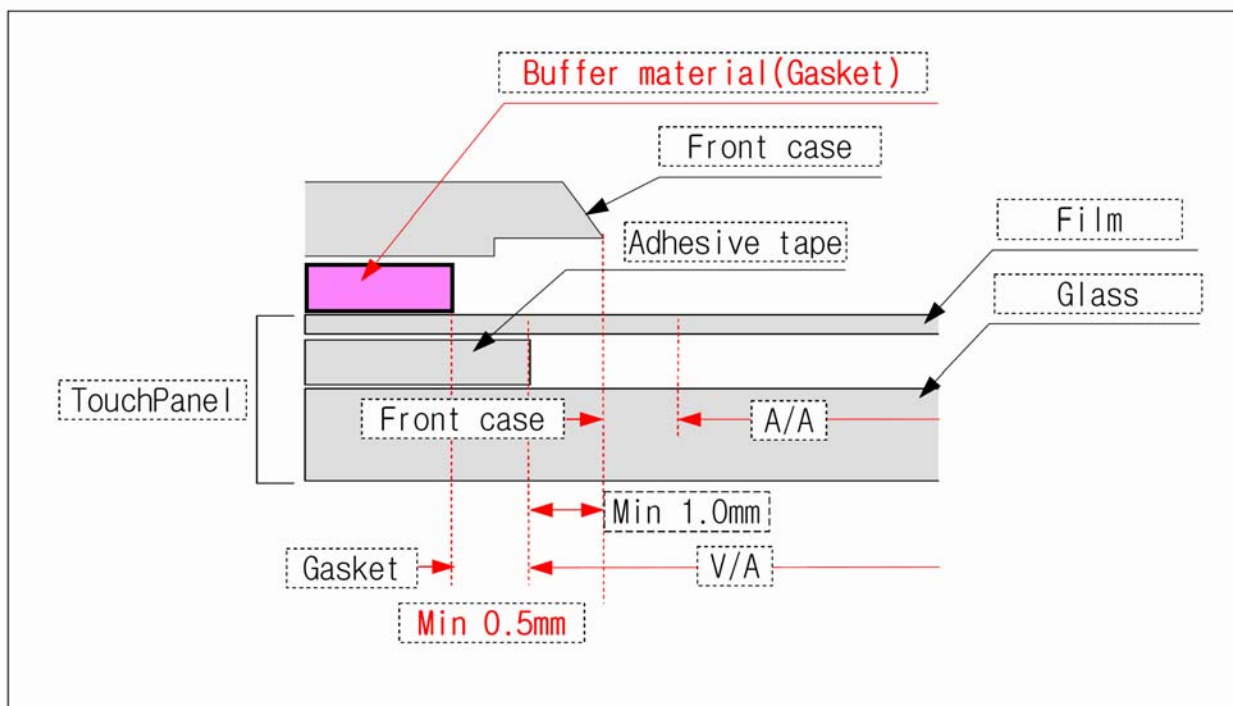
- Force : 250gf
- Speed : 2times/sec

4.3. Design Guide

- Avoid the design that Front-case overlap and press on the active area of the touch-panel.
- Give enough gap (over 0.5mm at compressed) between the front case and touch-panel to protect wrong operating.



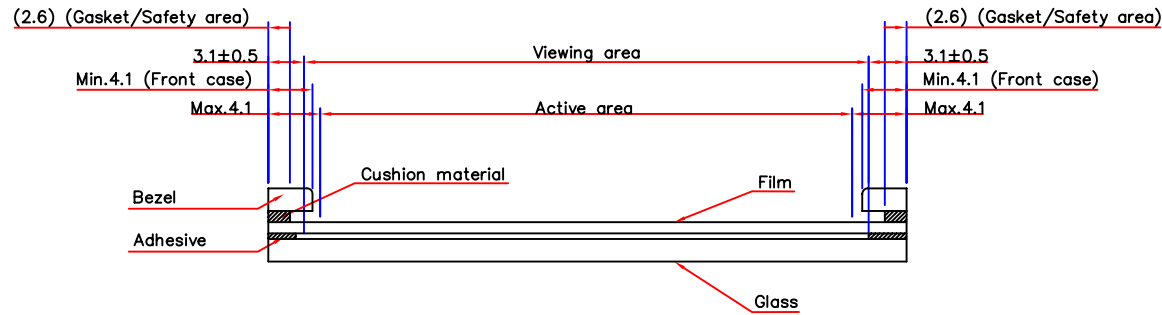
- Use a buffer material(Gasket) between the touch-panel and Front-case to protect damage and wrong operating.
- Avoid the design that buffer material overlap and press on the inside of touch-panel viewing area.



TSP Design Guide

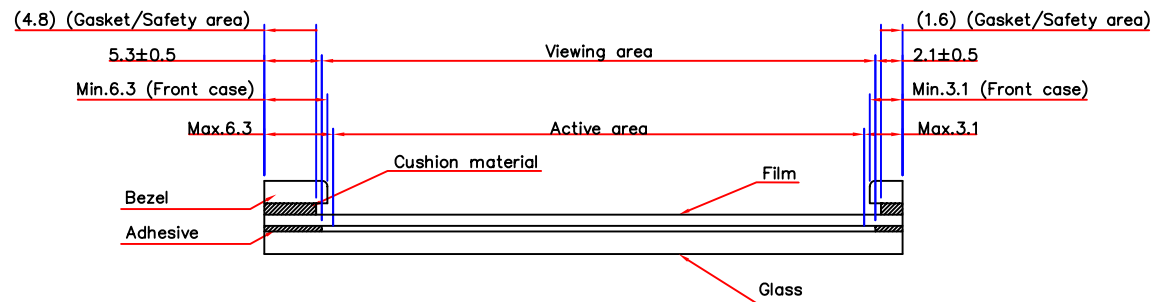
Left side

Right side



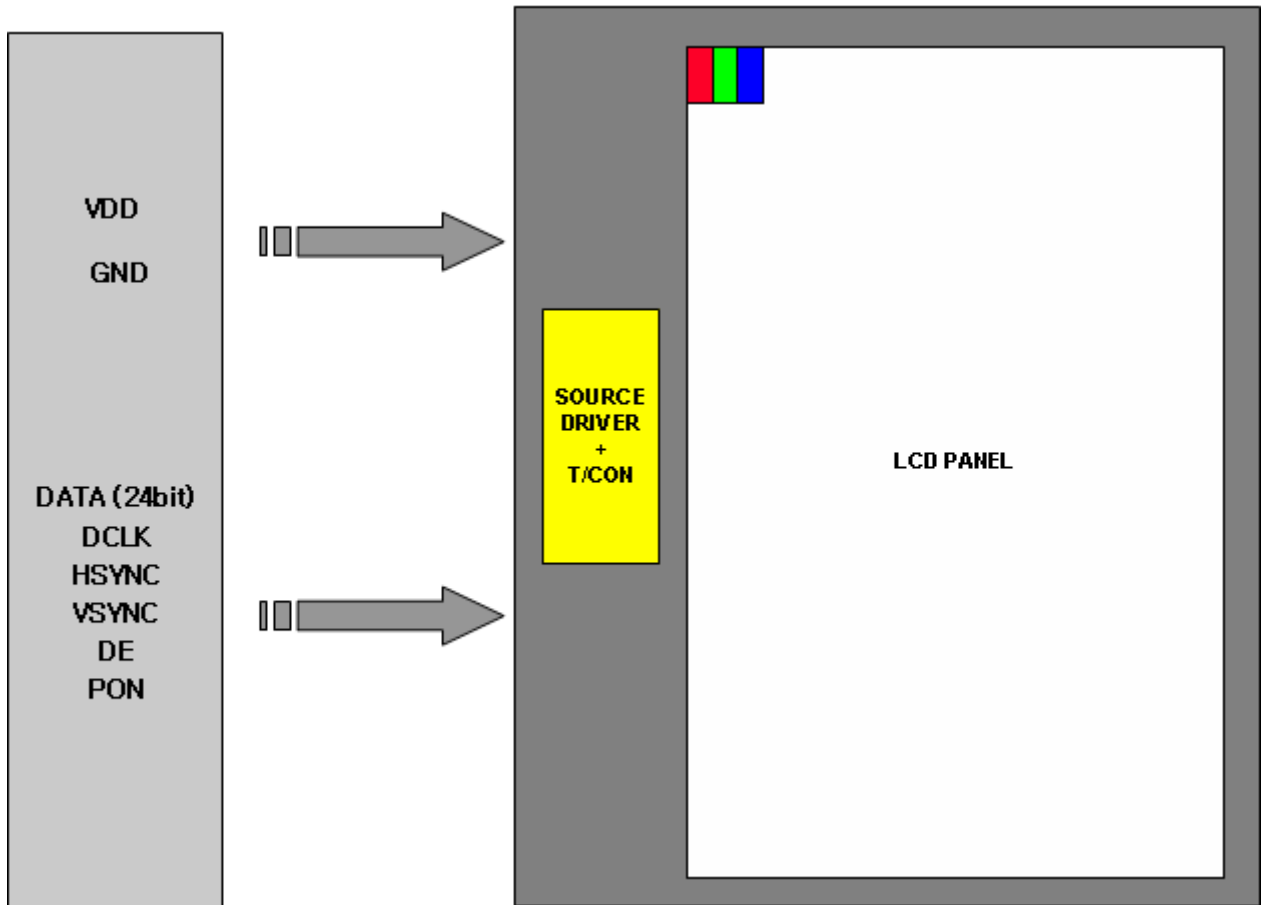
Bottom side

Top side

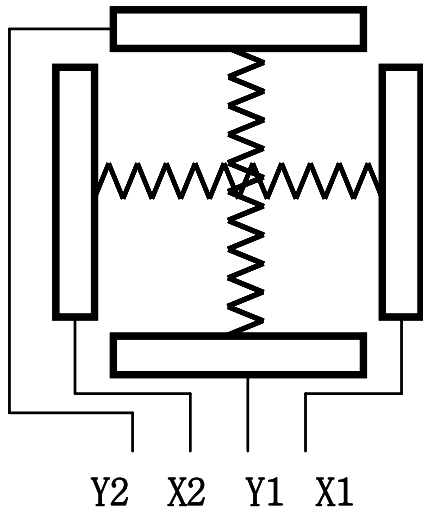


5. Block Diagram

5.1 TFT-LCD Module (Interface System Structure) with Back Light Unit



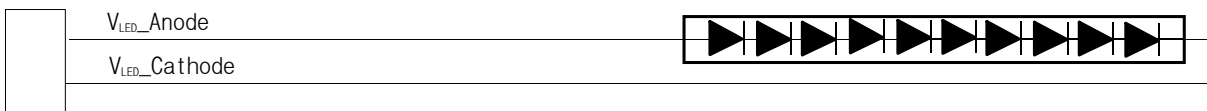
5.2 Touch Screen Panel



Top View

X : Upper electrode
Y : Lower electrode

5.3 Back-light Unit (Connector : 2 pin FPC Solder type)



6. Input Terminal Pin Assignment

6.1 Input Signal & Power (Connector type : 60Pin / 0.5mm pitch / Bottom contact)

- Hirose : FH12 series

Pin#	Symbol	Function	Remark	Pin#	Symbol	Function	Remark
1	VLED-	LED Cathode		31	G5	Green Data	
2	VLED-	LED Cathode		32	G6	Green Data	
3	VLED+	LED Anode		33	G7	Green Data	(MSB)
4	VLED+	LED Anode		34	R0	Red Data	(LSB)
5	GND	Ground		35	R1	Red Data	
6	X1	X_Right		36	R2	Red Data	
7	Y1	Y_Bot tom		37	R3	Red Data	
8	X2	X_Left		38	R4	Red Data	
9	Y2	Y_Up		39	R5	Red Data	
10	GND	Ground		40	R6	Red Data	
11	GND	Ground		41	R7	Red Data	(MSB)
12	GND	Ground		42	HSYNC	Horizontal Sync Signal	
13	GND	Ground		43	VSYNC	Vertical Sync Signal	
14	PON	Display on/off		44	PCLK	Pixel Clock	
15	GND	Ground		45	DE	Data Enable	
16	GND	Ground		46	NC	No Connect	
17	GND	Ground		47	VDD	Power Supply (3.3V)	
18	B0	Blue Data	(LSB)	48	VDD	Power Supply (3.3V)	
19	B1	Blue Data		49	GND	Ground	
20	B2	Blue Data		50	GND	Ground	
21	B3	Blue Data		51	GND	Ground	
22	B4	Blue Data		52	GND	Ground	
23	B5	Blue Data		53	GND	Ground	
24	B6	Blue Data		54	GND	Ground	
25	B7	Blue Data	(MSB)	55	GND	Ground	
26	G0	Green Data	(LSB)	56	GND	Ground	
27	G1	Green Data		57	GND	Ground	
28	G2	Green Data		58	GND	Ground	
29	G3	Green Data		59	GND	Ground	
30	G4	Green Data		60	GND	Ground	

6.2 Input Signal, Basic Display Colors and Gray Scale of Each Colors

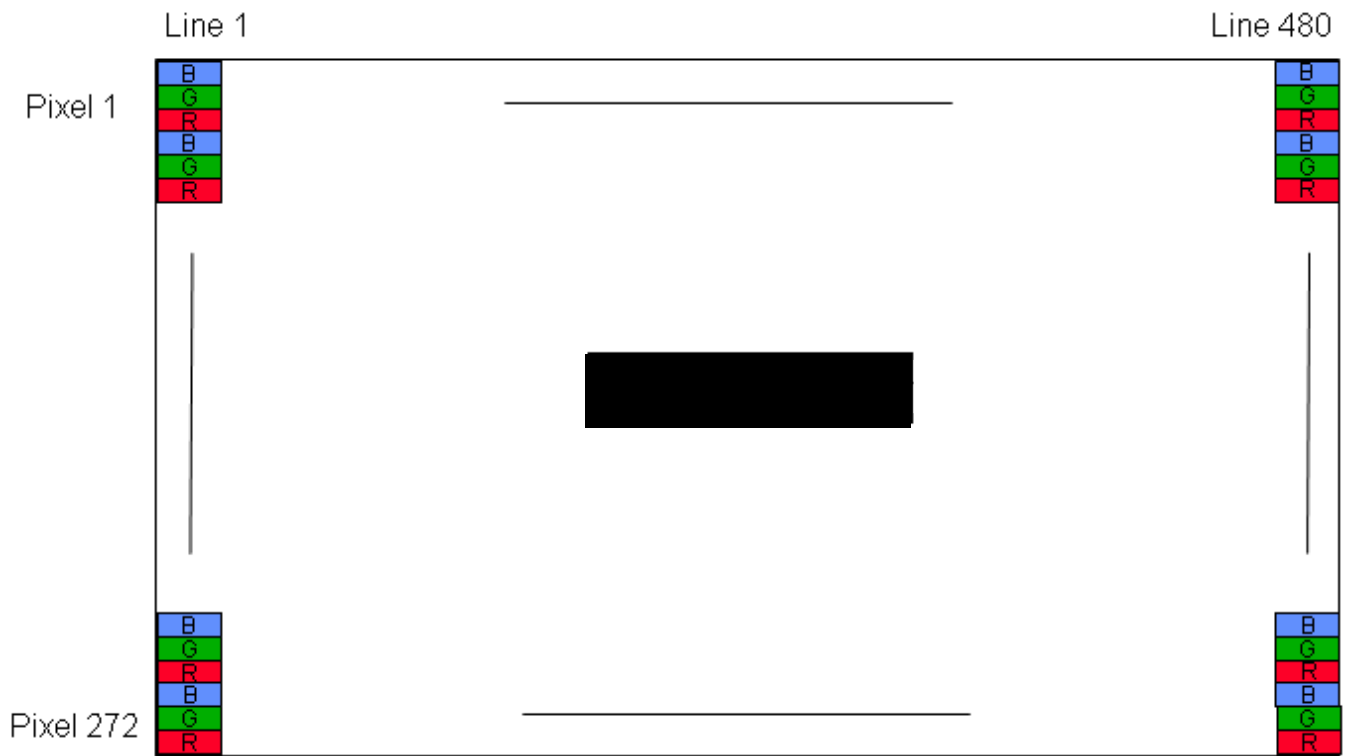
COLOR	DISPLAY	DATA SIGNAL																				GRAY SCALE LEVEL				
		RED							GREEN							BLUE										
		R0	R1	R2	R3	R4	R5	R6	R7	G0	G1	G2	G3	G4	G5	G6	G7	B0	B1	B2	B3		B4	B5	B6	B7
BASIC COLOR	BLACK	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	-	
	BLUE	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1	1	1	1	1	1	1	-
	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	-
	MAGENTA	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	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	R1	
		0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	R2	
		:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	R3~R252	
		:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:		:
	LIGHT ↓	1	0	1	1	1	1	1	1	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	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	R255	
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	G0	
	DARK ↑	0	0	0	0	0	0	0	0	1	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	G2	
		:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	G3~G252	
		:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:		:
	LIGHT ↓	0	0	0	0	0	0	0	0	1	0	1	1	1	1	1	1	0	0	0	0	0	0	0	G253	
		0	0	0	0	0	0	0	0	0	1	1	1	1	1	1	1	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	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	B0	
	DARK ↑	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	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	B2	
		:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	B3~B252	
		:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:		:
	LIGHT ↓	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	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	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	B255	

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

6.3 PIXEL FORMAT



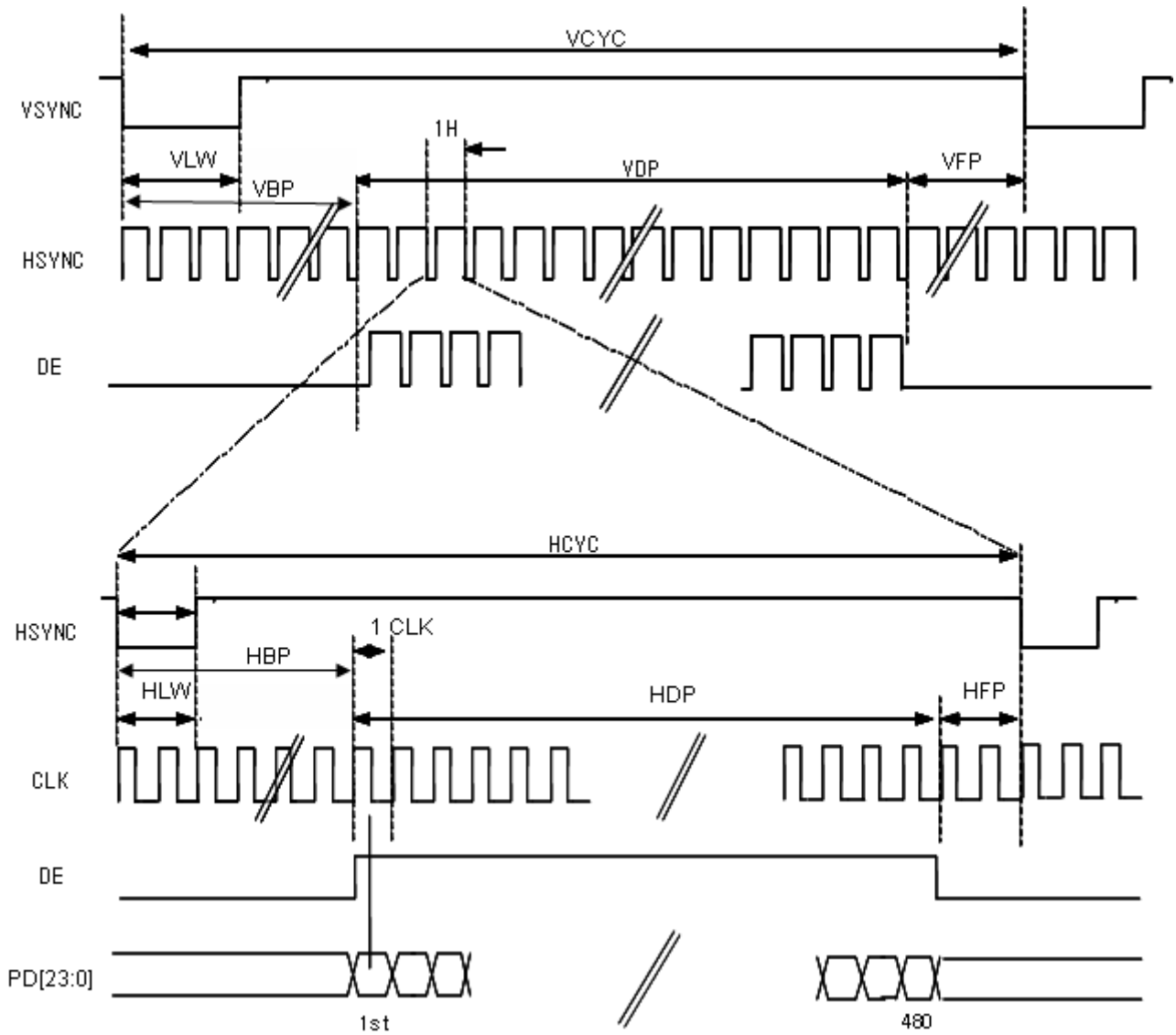
7. INTERFACE TIMING

7.1. Vertical timing

Signal	Symbol	Min.	Typ.	Max.	Unit	Note
Frame Frequency	fFRM	-	60	70	Hz	
VSYNC(Frame) Period	VCYC	248	288	335	H	
VSYNC Low width	VLW	1	10	-	H	
Vertical Display Period	VDP		272	-	H	
Vertical Back porch	VBP	-	12	-	H	
Vertical Front porch	VFP	2	4	-	H	

7.2. Horizontal timing

Signal	Symbol	Min.	Typ.	Max.	Unit	Note
HSYNC(1H) Period	HCYC	490	533	605	DOTCLK	
HSYNC Low width	HLW	4	41	-	DOTCLK	
Horizontal Display Period	HDP	-	480	-	DOTCLK	
Horizontal Back porch	HBP	8	45	-	DOTCLK	
Horizontal Front porch	HFP	2	8	-	DOTCLK	
DOTCLK Frequency	f _{DOTCLK}	-	9.2	15	MHz	@fFRM=60Hz



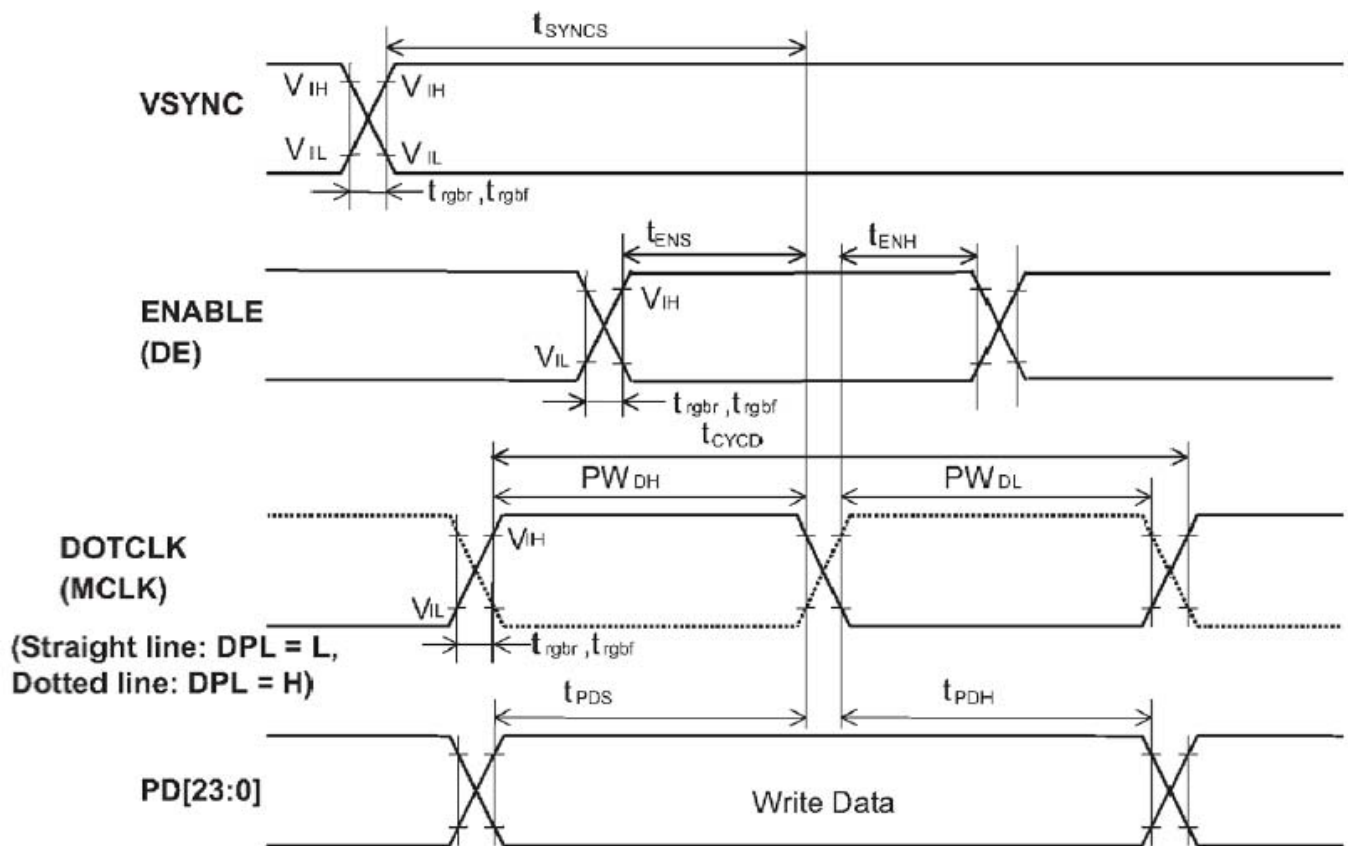
7.3. AC characteristics

※ Operating at VDD=2.25~2.9V , Ta = -40°C~+85°C

Parameter	Symbol	Min.	Typ.	Max.	Unit
VSYNC,HSYNC setup time	t _{SYNCS}	10	-	-	ns
ENABLE (DE) setup time	t _{ENS}	10	-	-	
ENABLE (DE) hold time	t _{ENH}	10	-	-	
DOTCLK "Low" level pulse width	P _{WDL}	25	-	-	
DOTCLK "High" level pulse width	P _{WDH}	25	-	-	
DOTCLK cycle time	t _{CYCD}	66.7	-	-	
Data setup time	t _{PDS}	10	-	-	
Data hold time	t _{PDH}	10	-	-	
DOTCLK,VSYNC,HSYNC clock rise/fall time	t _{rgbr} t _{rgbf}	-	-	5	

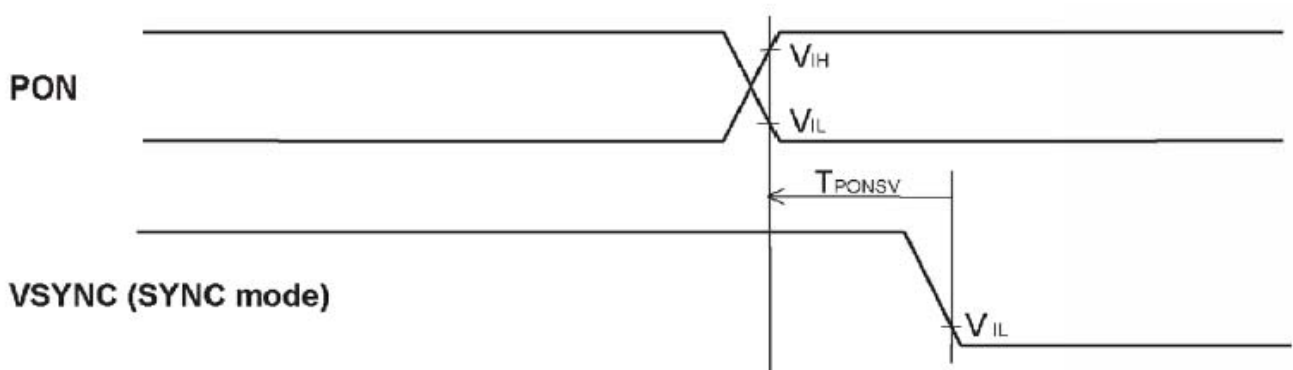
※ Operating at VDD=2.9~3.5V , Ta = -40°C~+85°C

Parameter	Symbol	Min.	Typ.	Max.	Unit
VSYNC,HSYNC setup time	t _{SYNCS}	10	-	-	ns
ENABLE (DE) setup time	t _{ENS}	10	-	-	
ENABLE (DE) hold time	t _{ENH}	10	-	-	
DOTCLK "Low" level pulse width	P _{WDL}	25	-	-	
DOTCLK "High" level pulse width	P _{WDH}	25	-	-	
DOTCLK cycle time	t _{CYCD}	66.7	-	-	
Data setup time	t _{PDS}	10	-	-	
Data hold time	t _{PDH}	10	-	-	
DOTCLK,VSYNC,HSYNC clock rise/fall time	t _{rgbr} t _{rgbf}	-	-	5	



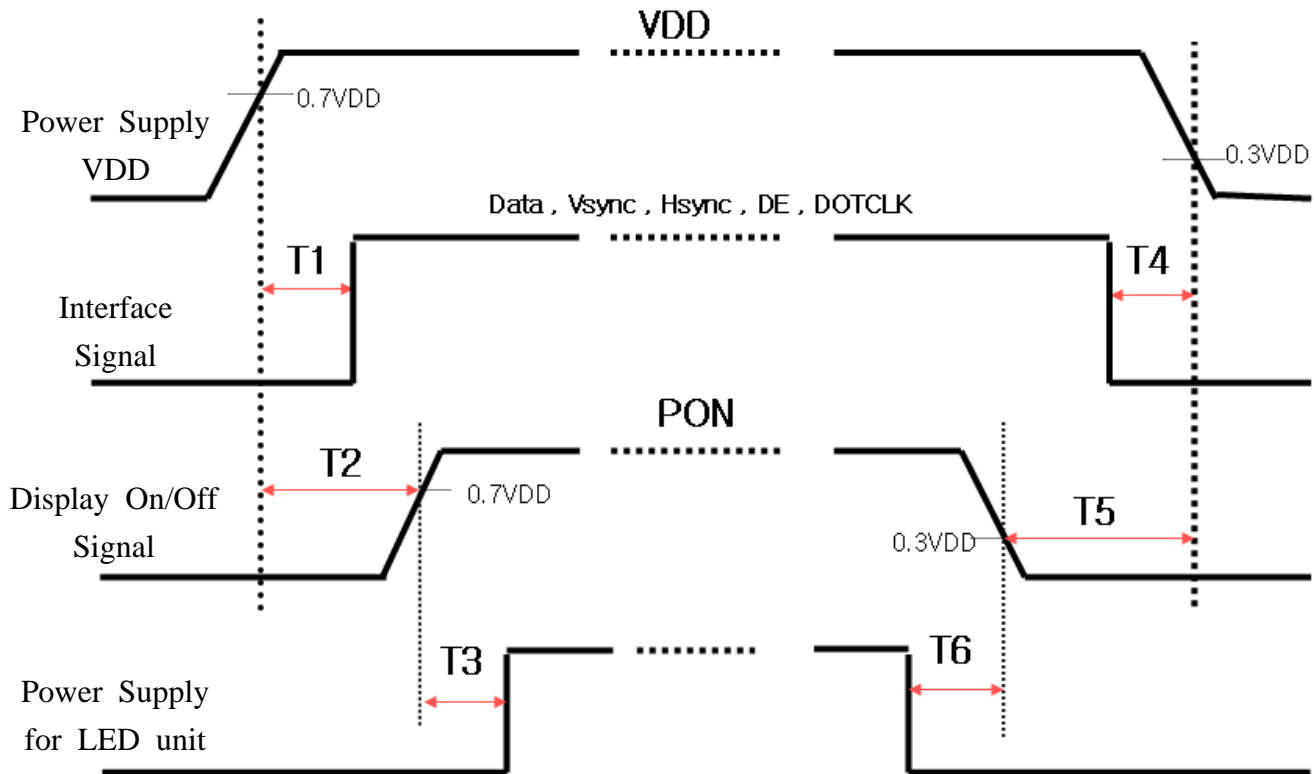
7.4. PON timing characteristics.

Item	Symbol	Min.	Typ.	Max.	unit
PON setup (SYNC mode)	$t_{PONS\bar{V}}$	10	-	-	DOTCLK



8. Power On/Off Sequence

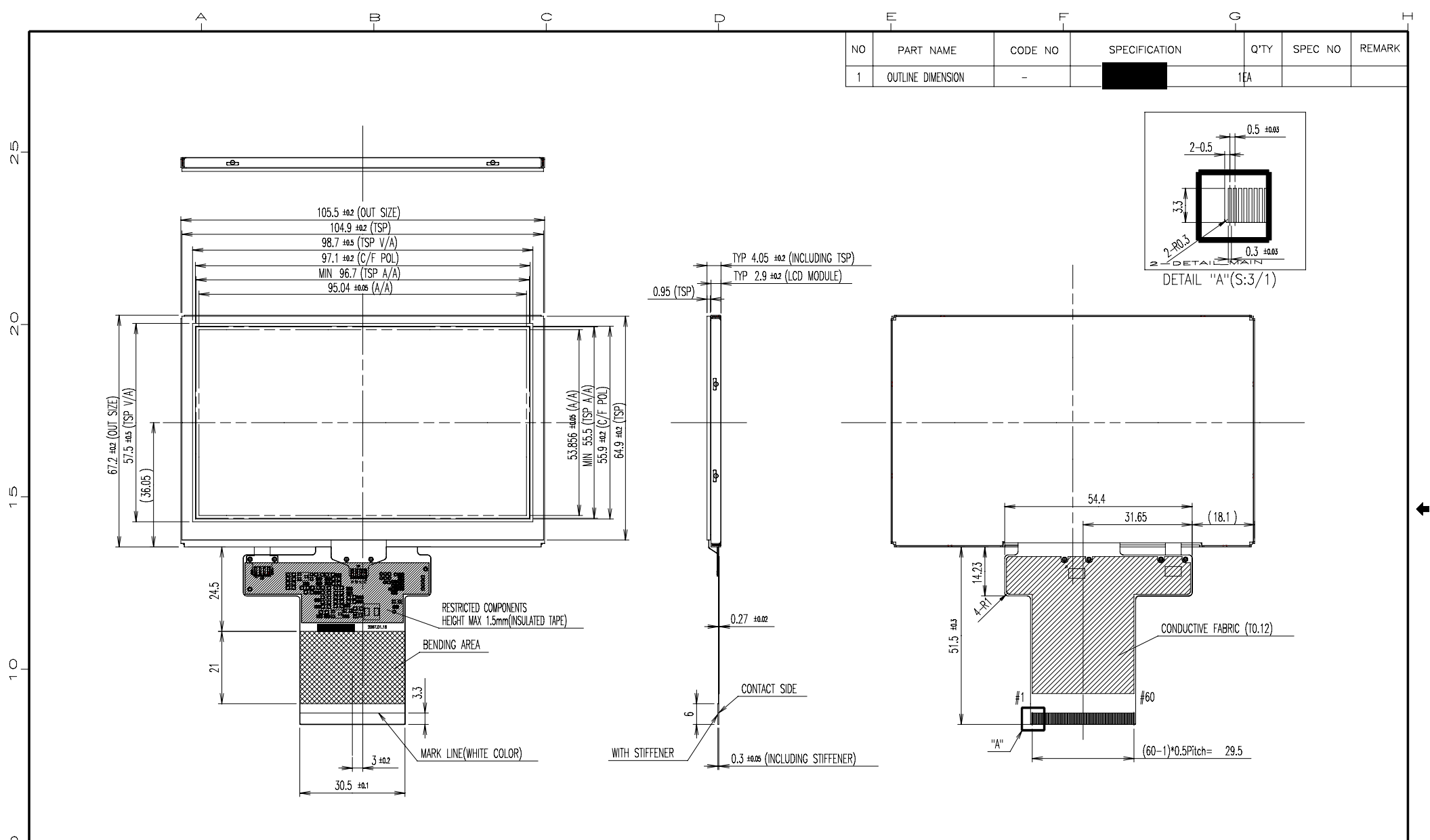
- To prevent a latch-up or DC operation of the LCD module, the power on/off sequence should be as the diagram below.



Symbol	Specification	Note
T1	$0 \text{ ms} < T1 < T2$	
T2	$10 \text{ ms} < T2$	(1)
T3	$10 \text{ frames} < T3$	
T4	$10 \text{ ms} < T4 < T5$	
T5	$(5 \text{ frames} + T4) < T5$	(1)
T6	$10 \text{ frames} < T6$	

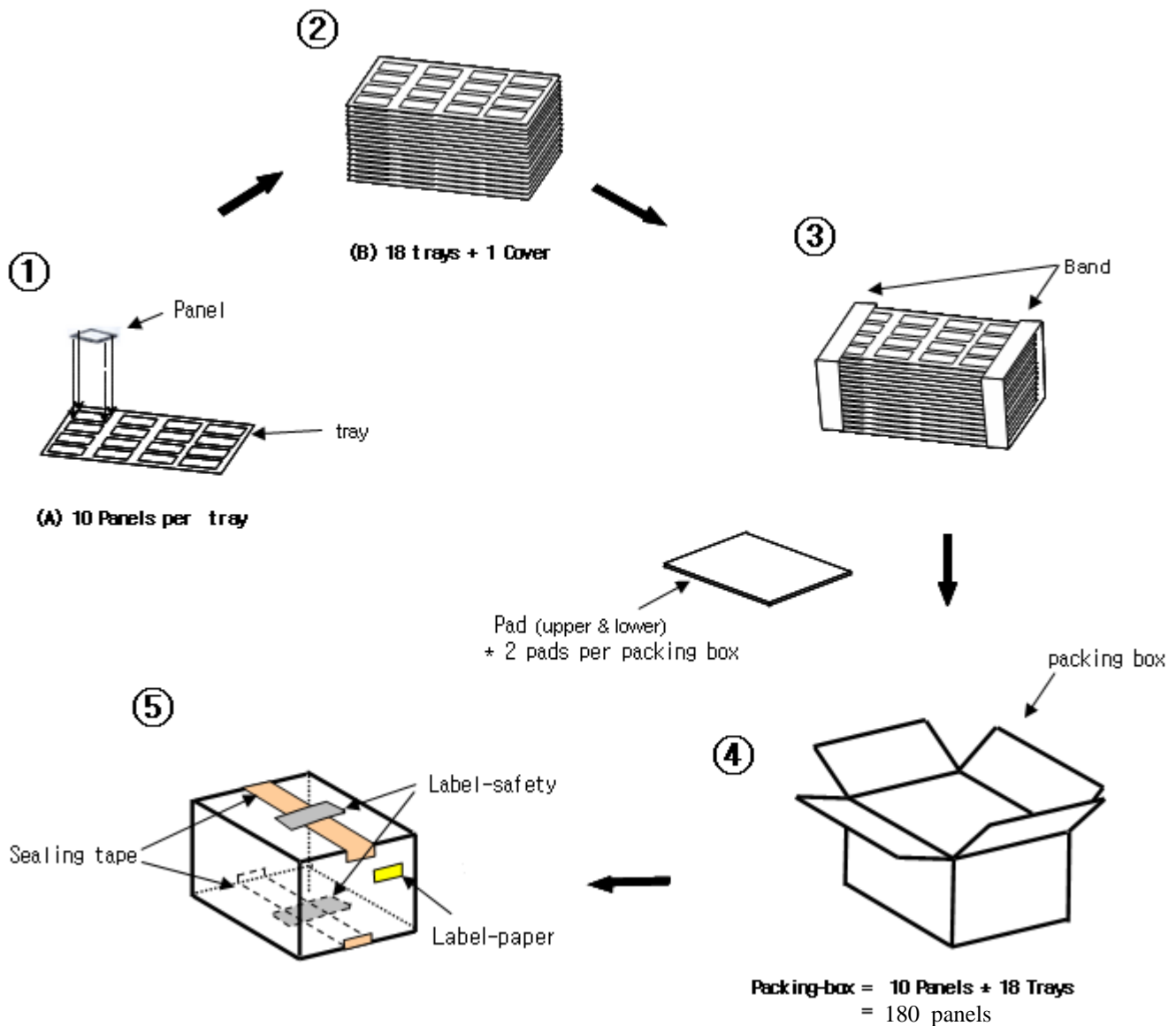
Note(1) Refer to "7-4. PON timing characteristics."

NO	PART NAME	CODE NO	SPECIFICATION	Q'TY	SPEC NO	REMARK
1	OUTLINE DIMENSION	-		1EA		



REV S O N	GENERAL TOLERANCE				REVISION				REASON		CHG'D BY		
	STEP	LEVEL 1	LEVEL 2	LEVEL 3	REV	DATE	DESCRIPTION OF REVISION			MODEL NAME	PART/SHEET NAME	SHEET	1/1
					UNIT	mm	DRA'N BY	DES'D BY	CHK'D BY				
	0 < X ≤ 4	±0.05	±0.1	±0.2	SCALE	1 / 1	T.J.KIM			Y.B.CHU			
4 < X ≤ 16	±0.08	±0.15	±0.3	TOLERANCE	LEVEL3	07.02.15			07.02.15	OUTLINE DIMENSION			
16 < X ≤ 64	±0.12	±0.25	±0.5	SAMSUNG ELECTRONICS				SPEC. NO					
64 < X ≤ 256	±0.25	±0.4	±0.8			CODE NO.				VER.	000		

10. Packing



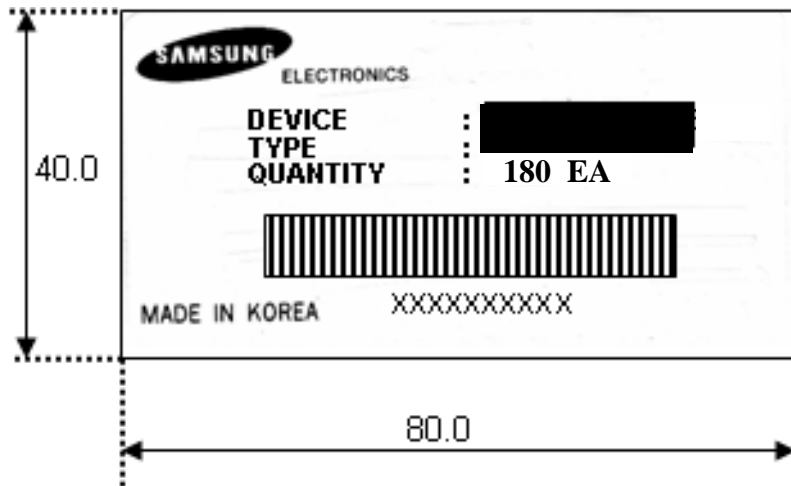
Note

- (1) Total : Box: Approx. : 13.7 Kg
- (2) Size : Box: 505(W) x 355(D) x 200(H)
- (3) Place the panels in the tray facing the direction shown in the figure.
- (4) Place 18 tray and cover(empty tray) and pads inside the packing-box.
- (5) Seal the packing-box. Affix the label-safety.

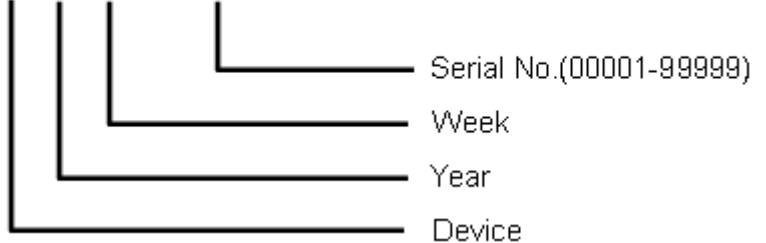
11. Marking & Others

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

(1) Packing case attach



X X X X X X X X X X



12. General Precautions

12.1 Handling

- (a) When the module is assembled, it should be attached to the system firmly. Be careful not to twist and bend the module.
- (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 back-light unit.
- (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(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.
- (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 Integrated Gate Circuit.
- (i) Use finger-stalls 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 adjust the variable resistor which is located on the back side.
- (l) Protection film for polarizer on the module shall be slowly peeled off just before use so that the electrostatic charge can be minimized.
- (m) Pins of I/F connector shall not be touched directly with bare hands

12.2 Storage

- (a) Do not leave the panel 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.

12.3 Operation

- (a) Do not connect, 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 shall be done by system manufacturers. Grounding and shielding methods may be important to minimize the interference.

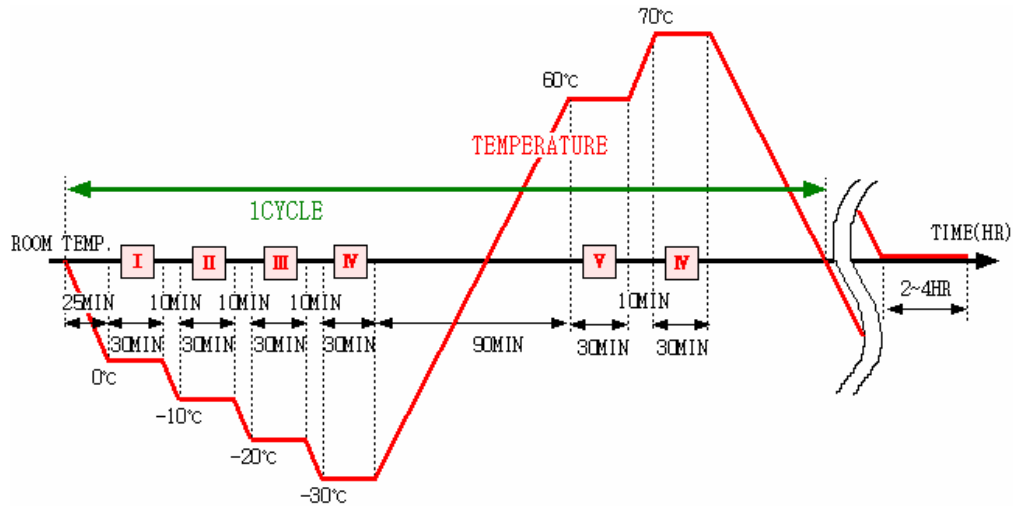
12.4 Others

- (a) The Liquid crystal is deteriorated by ultraviolet, do not leave it in direct sunlight and strong ultraviolet ray for many hours.
- (b) Avoid condensation of water. It may result in improper operation or disconnection of electrode.
- (c) Do not exceed the absolute maximum rating value. (the supply voltage variation, input voltage variation, variation in part contents and environmental temperature, and so on) Otherwise the panel may be damaged.
- (d) If the panel 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 panel has its circuitry FPC on the bottom side and should be handled carefully in order not to be stressed.
- (f) Avoid shortness between LED soldering pad.

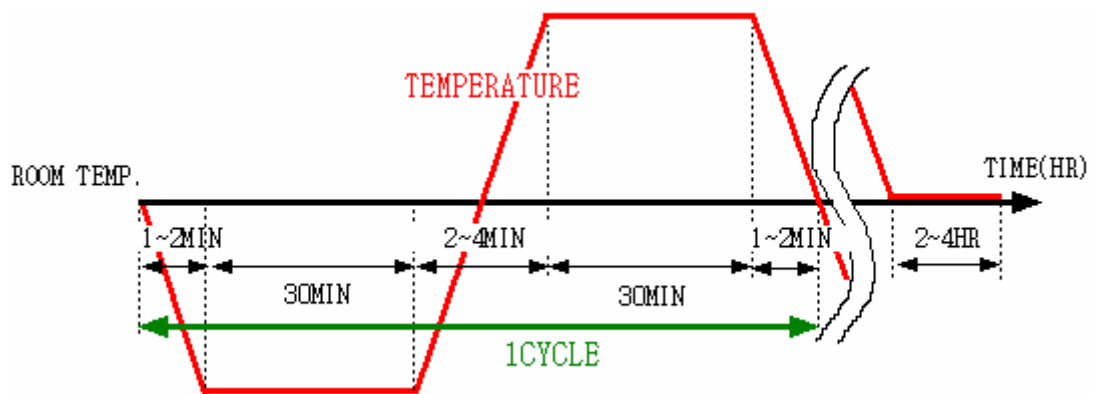
13. Reliability Test Result

Item	Condition	Sample Size	Test Result	Remark
High Temperature Operating Life test	70°C 240HR	10EA	PASS	
Low Temperature Operating Life test	-20°C 240HR	5EA	PASS	
Thermal Humidity Bias	60°C 90%RH 240HR	10EA	PASS	
On/Off Test	70°C ⇔ -30°C (5CYC),	10EA	PASS	Note(1)
High Temperature Storage test	85°C 240HR	5EA	PASS	
Low Temperature Storage test	-40°C 240HR	5EA	PASS	
Wet Humidity Temperature Storage test	60°C/90%RH 240HR	10EA	PASS	
Altitude test	Non-operating:188mb/Room Temp. 72HR	5EA	PASS	
Thermal Cycle storage test	-40~85°C, 30CYC	10EA	PASS	Note(2)
Electrical Static Discharge	Contact:±4kV, 150pF/330Ω Non-contact:±8kV, 150pF/330Ω	5EA 5EA	PASS	Note(3)
Box Vibration	Random Vibration MIN-STD 810E, up/down(Z)Axis	(1BOX Small)	PASS	Note(4)
Box Drop	1 corner, 3 edges, 6 surfaces under 9.1kg:76cm, 9.2~18.2kg: 66cm	(1BOX Medium)	PASS	
Crunch Test	10kgf, 30s, LCM and T/P don't break	5 EA	PASS	

Note(1) ON Time over 10 seconds, OFF Time under 10 seconds.



Note(2) STORAGE



Note(3) Main-LCD, 5 times to every 4 corners of active area.

Note(4) Basic transportation by common carrier environmental, 514.4 MIL-STD-810E.

OVERALL RMS LEVEL	BREAK POINT					
	FREQUENCY	PSD VALUE	FREQUENCY	PSD VALUE	FREQUENCY	PSD VALUE
0.74G	10Hz	0.00650	121Hz	0.00300	340Hz	0.00003
	20Hz	0.00650	200Hz	0.00300	500Hz	0.00015
	120Hz	0.00020	240Hz	0.00150	-	-