SAMSUNG MOBILE DISPLAY

Preliminary

Product Information

ISSUE DATE : 2009-10-08
MODEL : LMS500HF01

Note : The Product and specifications are subject to change without any notice.
Please ask for the latest Product Standards to guarantee the satisfaction of your product requirements.

PREPARED BY : Samsung Mobile Display Development

Samsung Mobile Display

Preliminary

Revision History

Date	Rev. No.	Page	Summary
Oct.08.2009	000		Rev.000 was first issue.

Preliminary

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Preliminary

General Description

*** Description**

LMS500HF01 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 and a Touch Screen Panel(TSP).

The resolution of a 5.0" contains 480x272xRGB dots and can display up to 16.7M colors.

*** Features**

- Transmissive with Micro Reflective type and back-light with 14 LEDs are available.
- Using the Touch Screen Panel (Film-Glass type).
- VA(Normally black) mode.
- 24bit RGB Interface
- SYNC mode with DE(Data Enable) - DE, Vsync, Hsync, DOTCLK

*** Applications**

- Display terminals for PMP(Portable Multimedia Player), PND(Portable Navigation Display) application products.
- Display terminals for AV application products

* General information

Items	Specification	Unit	Note
Display area	110.88(H) x 62.832(V) (5.0" diagonal)	mm	-
Driver element	a-Si TFT active matrix	-	-
Display colors	16,777,216	colors	-
Number of pixels	480 x 272 x RGB	dot	-
Pixel arrangement	RGB stripe	-	-
Pixel pitch	0.231(H) x 0.231(V)	mm	109ppi
Display mode	Normally black	-	-

* Mechanical information

Item		Min.	Typ.	Max.	Unit	Note
Module size	Horizontal(H)	120.5	120.7	120.9	mm	-
	Vertical(V)	75.6	75.8	76.0	mm	(1)
	Depth(D)	4.05	4.25	4.45	mm	(1)
Weight		-	79	-	g	(2)

Note (1) Not include FPC.
Refer to the Outline Dimension in the "9. Outline Dimension" for further information.
(2) Touch Screen Panel and Back-light unit are included.

1. Absolute Maximum Ratings

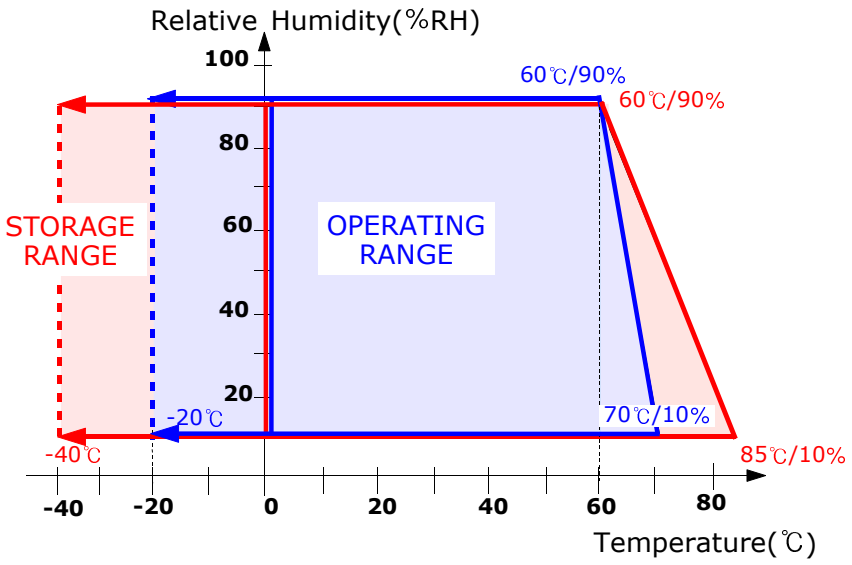
1.1 Absolute Ratings Of Environment

ITEM	MIN	MAX	REMARK
Storage Temperature	-40℃	85℃	Note(1)
Operating Temperature (Temperature of panel surface)	-20℃	70℃	Note(2)(3)

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

(2) When operated at a temperature lower than 0℃, 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 minutes, image-sticking phenomenon may occur.



<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
Digital power supply	VDD	-0.3	4.6	V	-

(2) Back-Light Unit

(Ta = 25 ± 2°C)

Item	Symbol	Min.	Max.	Unit.	Note
Current	I_B	-	50	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=3.3V , fv=60Hz , fDCLK=9.2MHz , I_B=40mA)

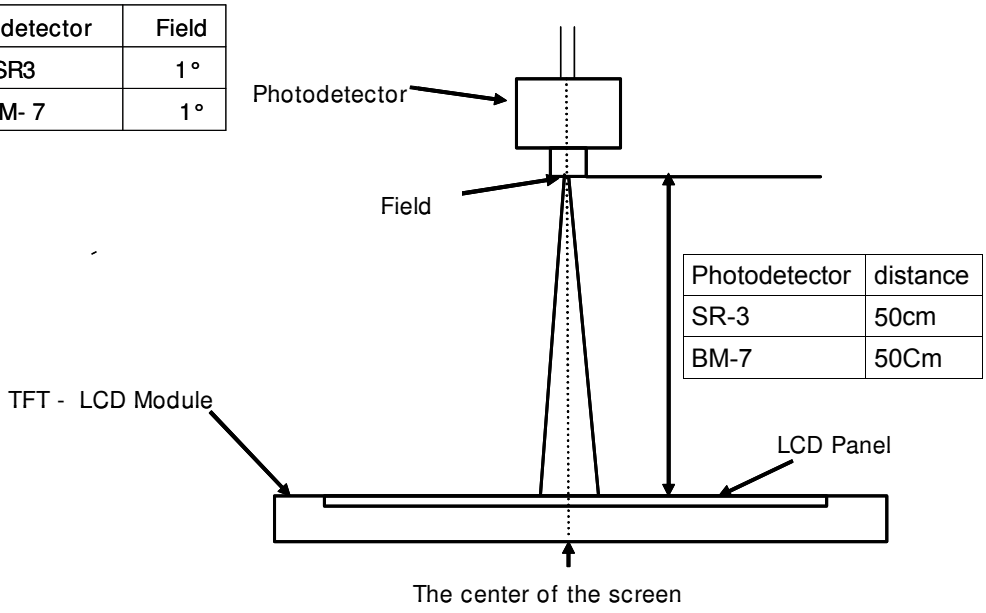
Item		Symbol	Condition	Min.	Typ.	Max.	Unit	Note
Contrast ratio (Center point)		C/R	NOTE (1)	400	800	-	-	(2) SR3
Luminance of white (Center point)		YL		300	400	-	cd/㎡	(3) SR3
Response time	Rising	T_R		-	17	22	msec	(4) BM-7
	Falling	T_F	θ = 0	-	15	20		
Color chromaticity (CIE 1931)	White	Wx	Φ = 0	0.28	0.32	0.36	-	(5) SR3
		Wy	Normal	0.30	0.34	0.38		
	Red	Rx	Viewing	0.56	0.60	0.64		
		Ry	Angle	0.32	0.36	0.40		
	Green	Gx		0.32	0.36	0.40		
		Gy	B/L On	0.53	0.57	0.61		
	Blue	Bx		0.11	0.15	0.19		
		By		0.08	0.12	0.16		
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 : Ta = 25 ± 2 °C

Back-Light On condition

Photodetector	Field
SR3	1°
BM- 7	1°



Photodetector	distance
SR-3	50cm
BM-7	50Cm

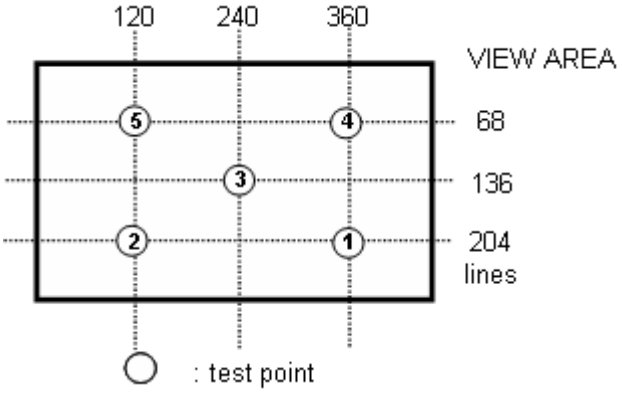
Note (2) Definition of Contrast Ratio (C/R)
: Ratio of gray max (Gmax) & gray min (Gmin) at the center point

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

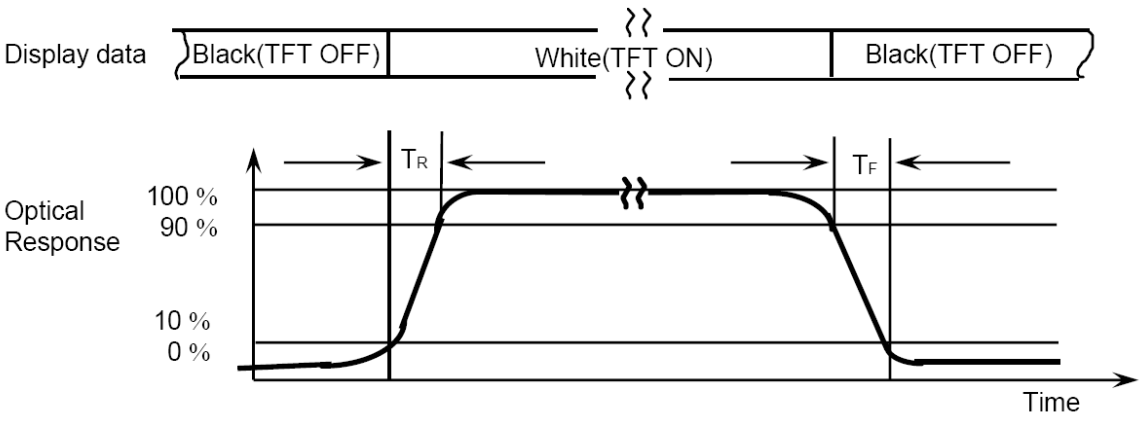
* Gmax : Luminance with all pixels white
* Gmin : Luminance with all pixels black

Note (3) Definition of Luminance of White

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



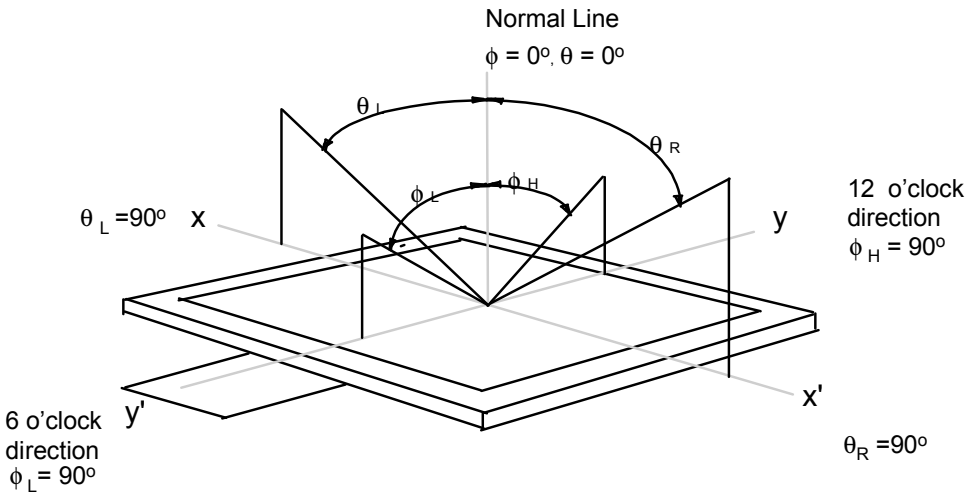
Note (4) Definition of Response time : Sum of Tr ,Tf



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≥1**0**)



3. Electrical Characteristics

3.1 TFT-LCD Module

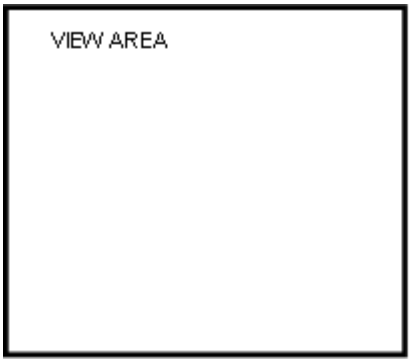
(Ta = 25 ± 2°C)

ITEM		Symbol	Min.	Typ.	Max.	Unit	Note
Digital power supply		VDD	2.9	3.3	3.5	V	
Input "High" level voltage		VIH	0.8*VDD	-	VDD	V	
Input "Low" level voltage		VIL	0	-	0.2*VDD	V	
Vsync Frequency		fv	-	60	70	Hz	
Hsync Frequency		f_H	-	17.28	-	kHz	
Main Frequency		f_{DCLK}	-	9.2	15.0	MHZ	
Power Dissipation	White	-	-	120	155	mW	(1),(2)
	Black		-	120	155	mW	

Note (1). fv=60Hz, f_{DCLK}=9.2MHZ, VDD=3.3V

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 14white LEDs.

(Ta=25 ± 2°C)

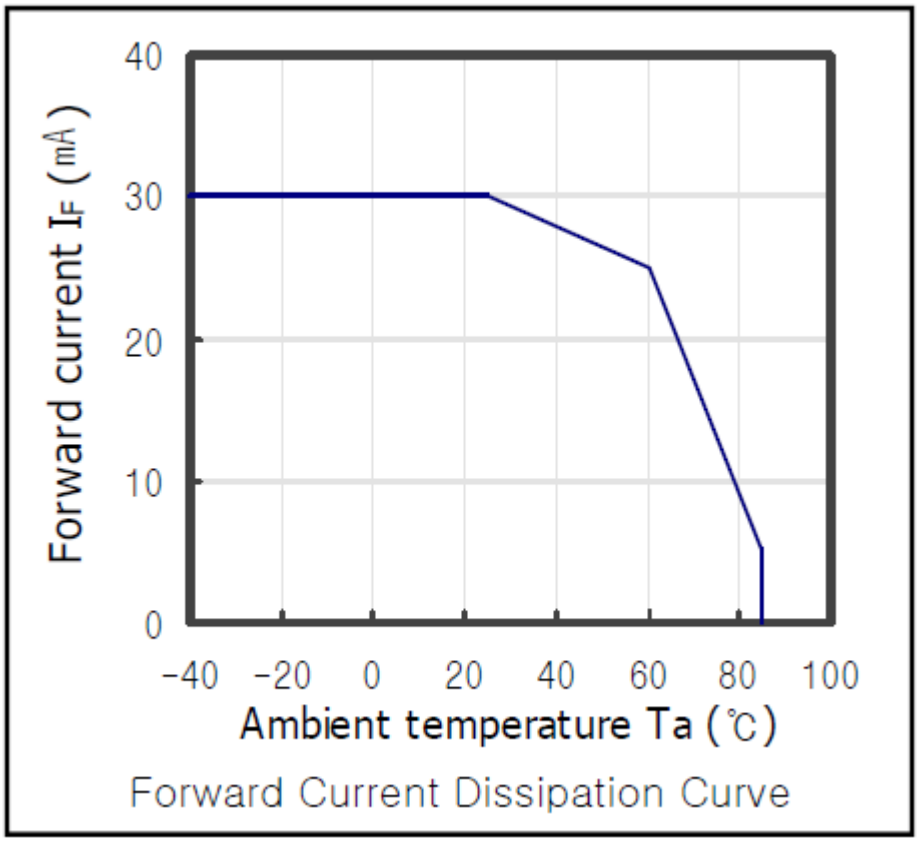
Item	Symbol	Min.	Typ.	Max.	Unit	Note
LEDs Current	I_B	-	40		mA	(1)(3)
Power Consumption	P_{BL}	-	930	-	mW	(2)(3)

Note (1) 14LEDs parallel type.

(2) Where I_B = 40mA, V_B = P_{BL} / I_B

(3) DC current(voltage) use only.
If PWM(pulse width modulation) used, some problems may be happened.

Ambient Temp vs. Allowable Forward Current.



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	100	-	1000	Ω	X
	100	-	1000	Ω	Y
Insulation resistance	10	-	-	MΩ	DC 25V
Voltage	-	-	7	V	DC
Chattering	-	-	10	ms	100kΩ 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

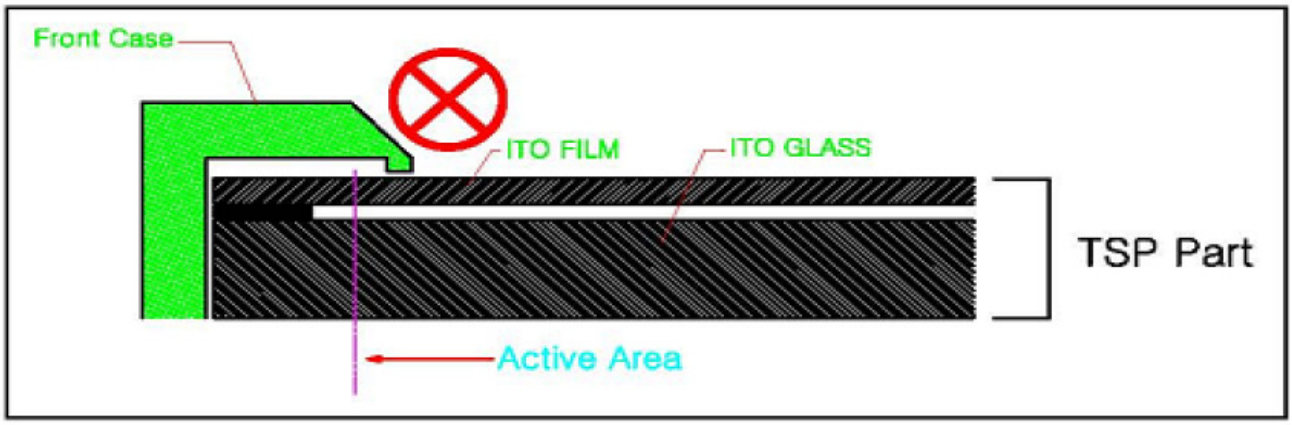
- Scratch 100,000 times straight line on the Film with a stylus change every 20,000times
- Force : 250gf
- Speed : 60mm/sec
- Stylus : R0.8 polyacetal tip

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

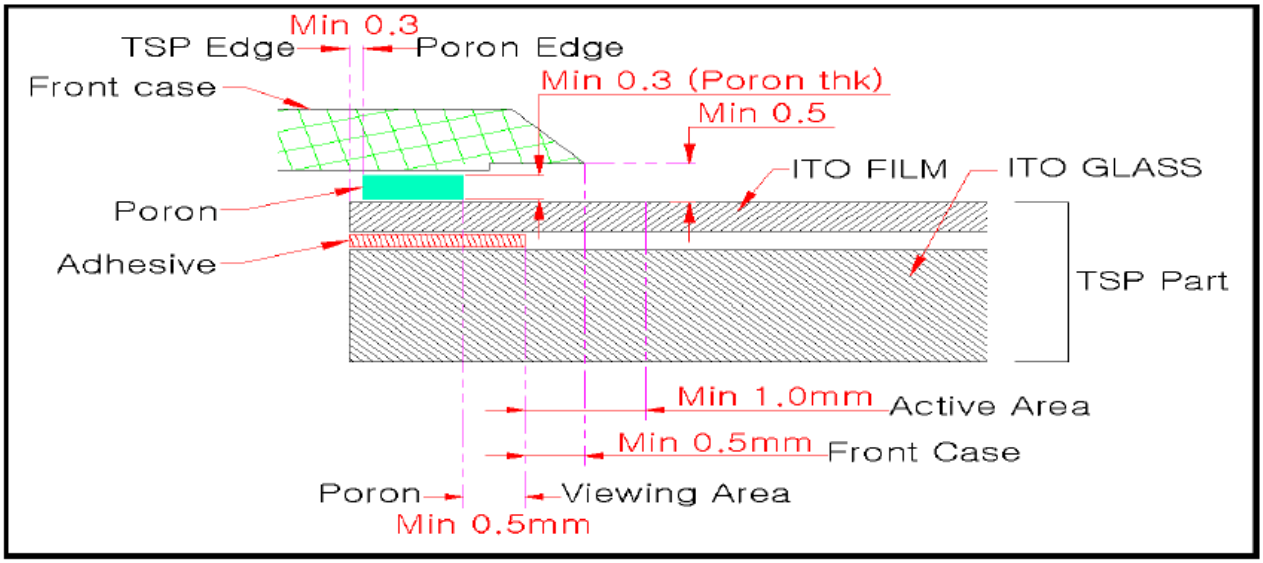
- Force : 250gf
- Speed : 2times/sec

4-3. Design Guide

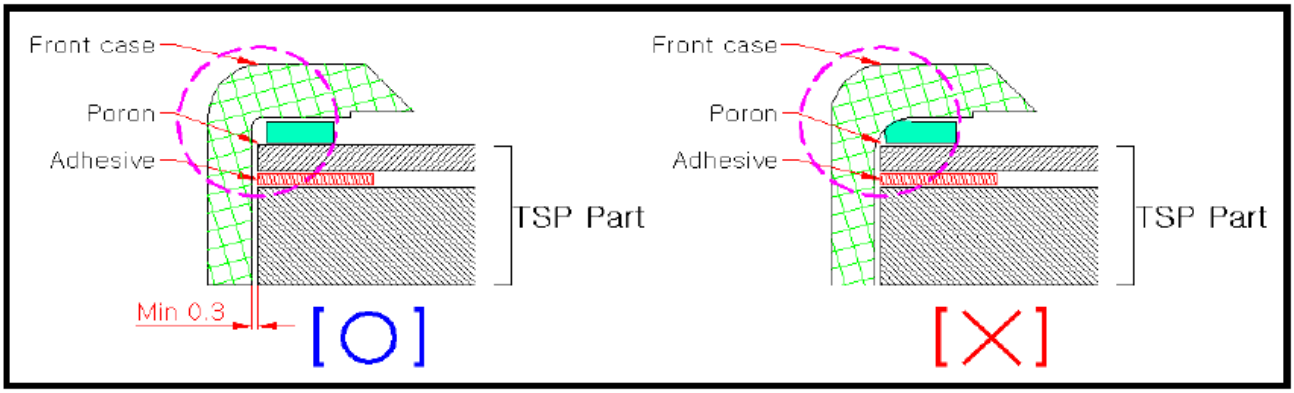
- The front case design as below.



- The following design recommendations, such as a picture.



- Recommend the use of a poron(cushion) materia between the panel and the bezel, cushion material should be limited only on the busbar area. If it is out of the busbar area, panel may occur a short.
- Poron(cushion) in the edge of the TSP to maintain the recommended minimum of 0.3mm
- Recommends a minimum thickness of 0.3 mm Poron(cushion).



- To Poron(cushion) the inside of the case should be no variation.

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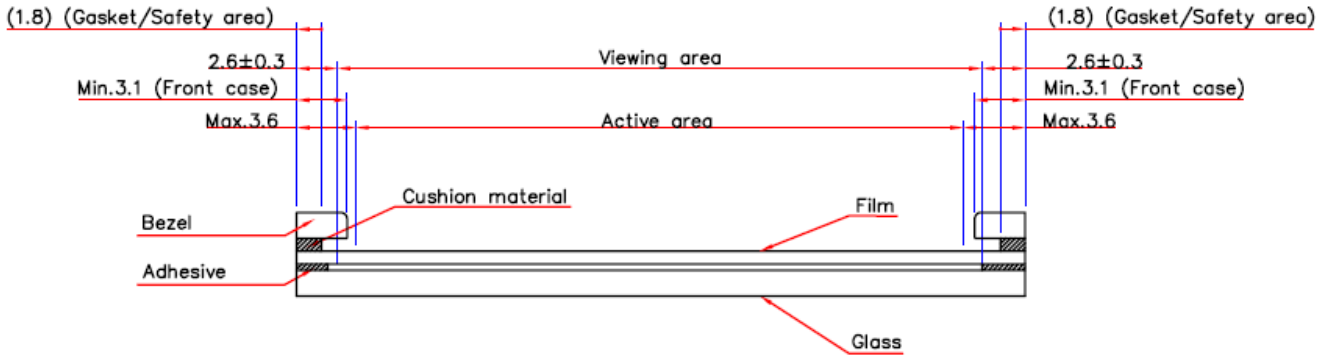
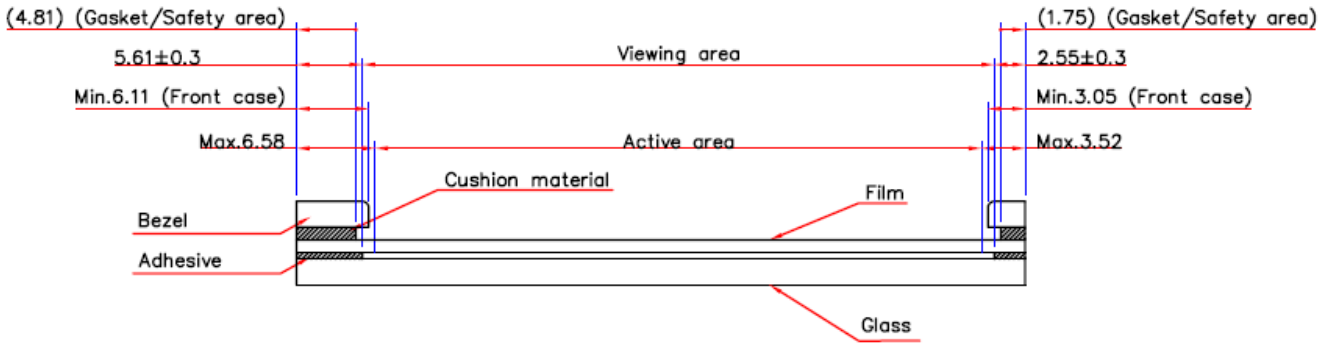
Left side

Right side



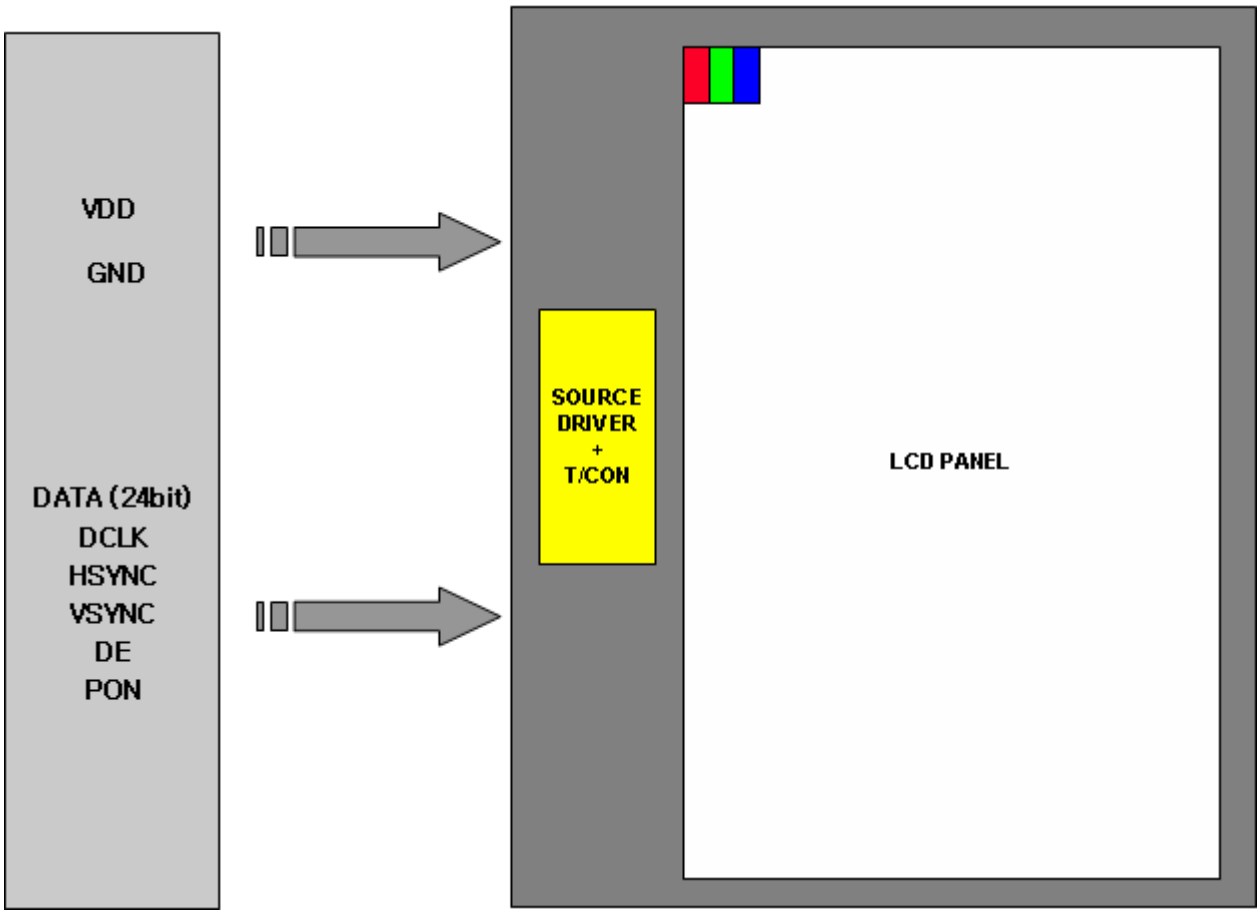
Bottom side

Top side

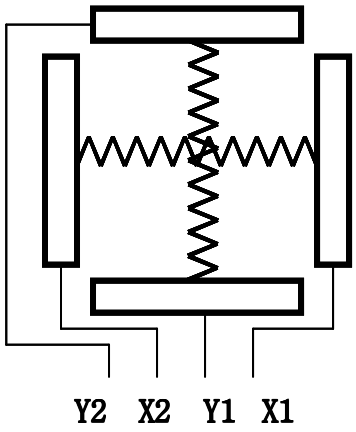


5. Block Diagram

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



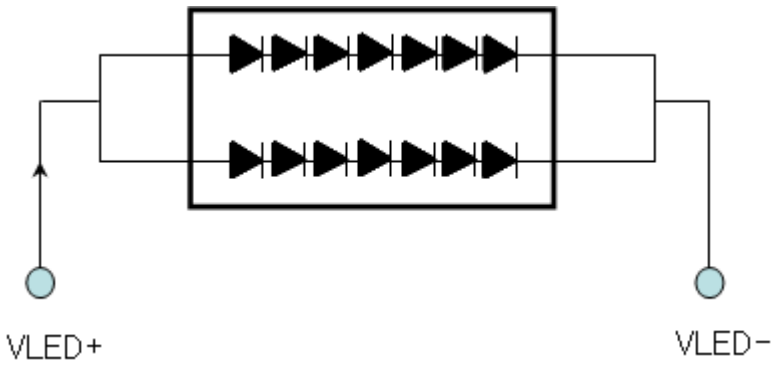
5.2 Touch Screen Panel



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 : 50Pin / 0.5mm pitch)
: Hirose : FH12 series

Pin#	Symbol	Function	Remark	Pin#	Symbol	Function	Remark
1	VSS	Ground		26	B5	Blue Data	
2	VSS	Ground		27	B6	Blue Data	
3	VDD	Power Supply	3.3V	28	B7	Blue Data	(MSB)
4	VDD	Power Supply	3.3V	29	VSS	Ground	
5	R0	Red Data	(LSB)	30	PCLK	Pixel Clock	
6	R1	Red Data		31	PON	Display on/off	
7	R2	Red Data		32	HSYNC	Horizontal Sync Signal	
8	R3	Red Data		33	VSYNC	Vertical Sync Signal	
9	R4	Red Data		34	DE	Data Enable	
10	R5	Red Data		35	VSS	Ground	
11	R6	Red Data		36	NC	Non Connect	
12	R7	Red Data	(MSB)	37	VSS	Ground	
13	G0	Green Data	(LSB)	38	NC	Non Connect	
14	G1	Green Data		39	NC	Non Connect	
15	G2	Green Data		40	VSS	Ground	
16	G3	Green Data		41	X1	X Right	
17	G4	Green Data		42	Y1	Y Bottom	
18	G5	Green Data		43	X2	X Left	
19	G6	Green Data		44	Y2	Y Up	
20	G7	Green Data	(MSB)	45	VSS	Ground	
21	B0	Blue Data	(LSB)	46	VLED-	LED backlight cathode	
22	B1	Blue Data		47	NC	Non Connect	
23	B2	Blue Data		48	VLED+	LED backlight anode	
24	B3	Blue Data		49	VSS	Ground	
25	B4	Blue Data		50	VSS	Ground	

6.2 Touch Screen Panel (Connector : 4Pin FPC Solder type)

Pin No.	Symbol	I/O	Function
41	**X1**	**Right**	**Right electrode - differential analog**
42	**Y1**	**Bottom**	**Bottom electrode - differential analog**
43	**X2**	**Left**	**Left electrode - differential analog**
44	**Y2**	**Top**	**Top electrode - differential analog**

6.3 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	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	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	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
	↓ LIGHT	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	
		1	0	1	1	1	1	1	1	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	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 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	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	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
	↓ LIGHT	:			:	:	:	:	:	:			:	:	:	:	:	:			:	:	:	:	:	
		0	0	0	0	0	0	0	0	1	0	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	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 ↑	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
	↓ LIGHT	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	
		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	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) 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

6.4 PIXEL FORMAT

7. INTERFACE TIMING

7-1. Vertical timing

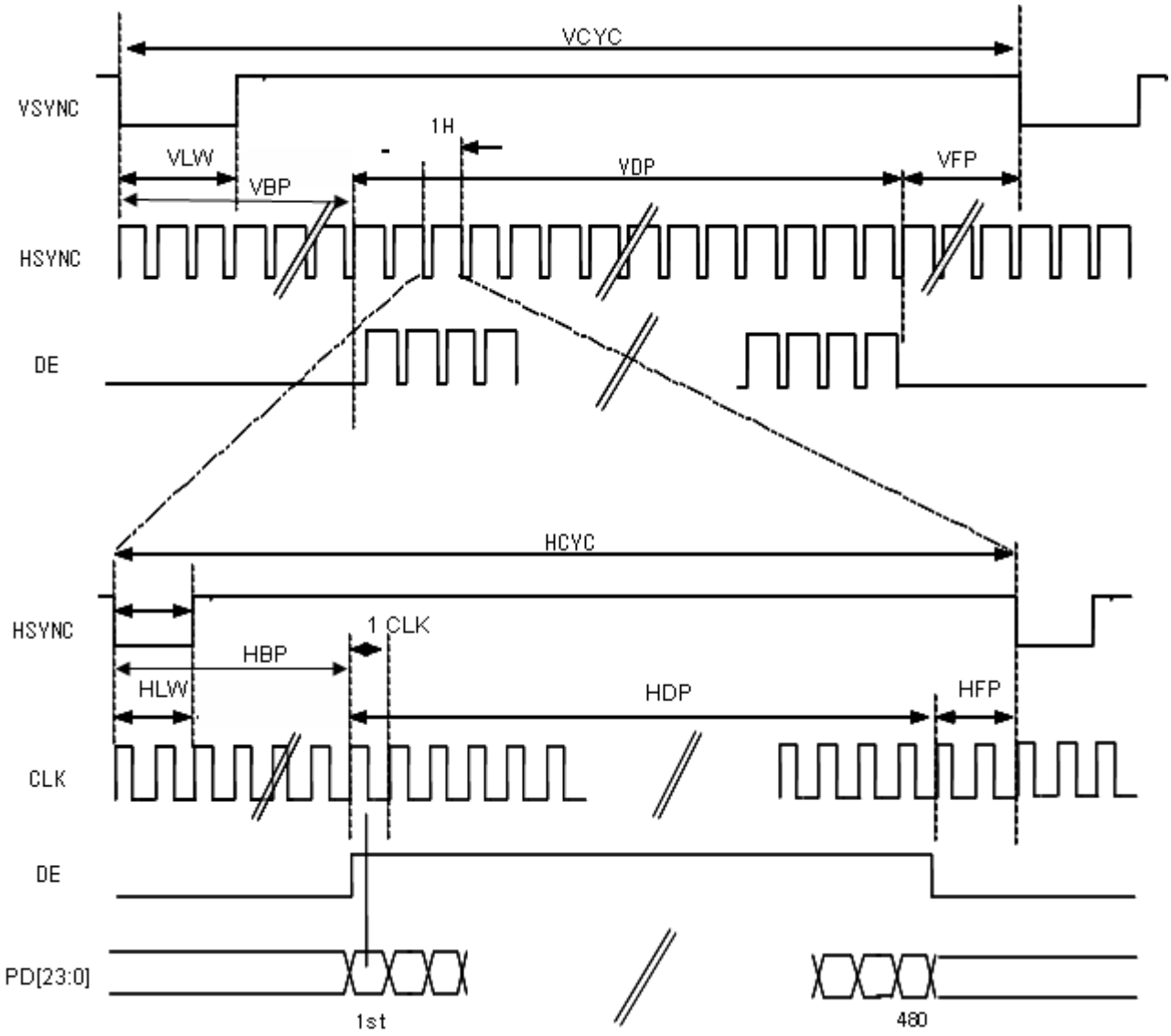
※ Operating at VDD=2.9~3.5V , Ta = -40℃~+85℃

Signal	Symbol	Min.	Typ.	Max.	Unit	Note
Frame Frequency	fFRM	60	60	70	Hz	
VSYNC(Frame) Period	VCYC	286	288	335	H	Min : VDP + VBP +VFP(Min)
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

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

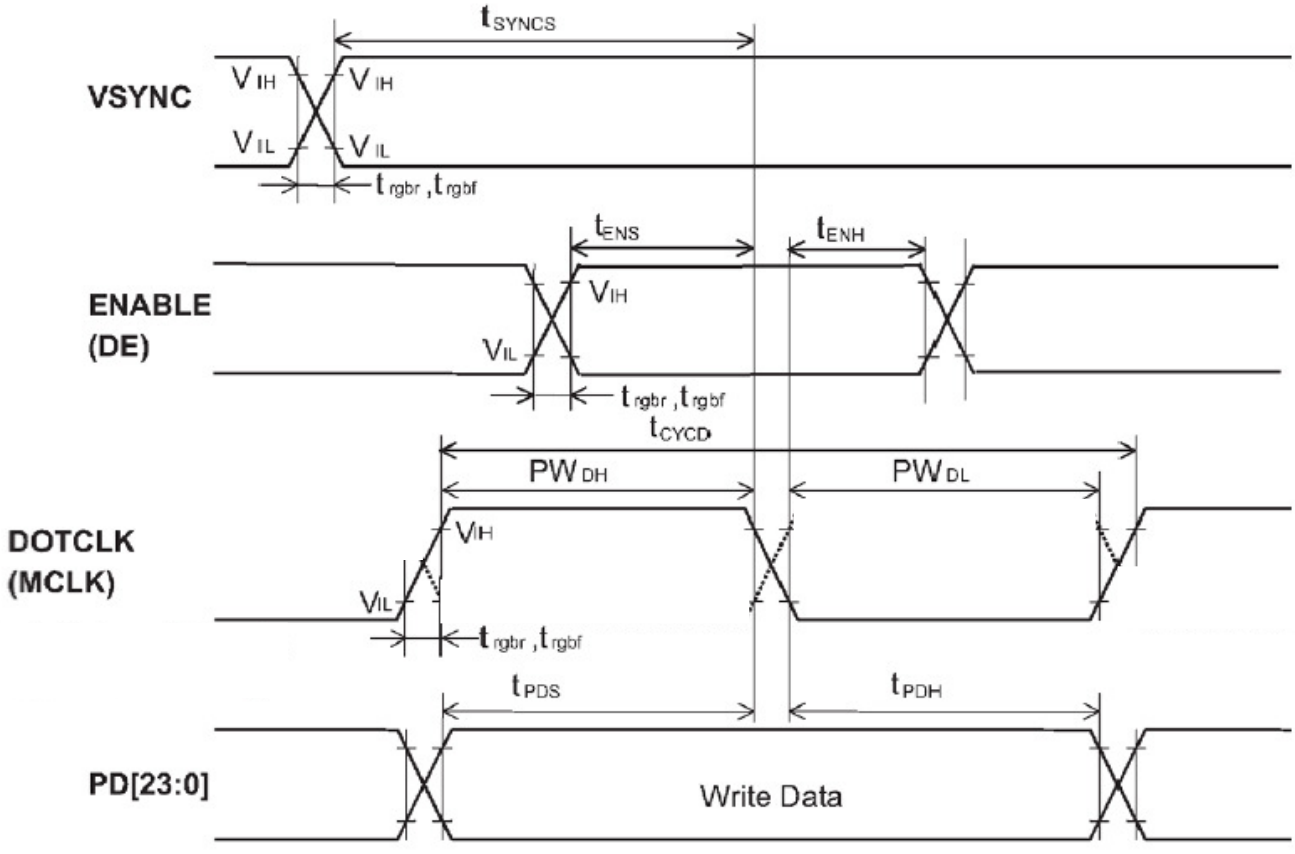
Signal	Symbol	Min.	Typ.	Max.	Unit	Note
HSYNC(1H) Period	HCYC	508	533	605	DOTCLK	
HSYNC Low width	HLW	4	41	80	DOTCLK	
Horizontal Display Period	HDP	-	480	-	DOTCLK	
Horizontal Back porch	HBP	26	45	-	DOTCLK	
Horizontal Front porch	HFP	2	8	-	DOTCLK	
DOTCLK Frequence	f_{DOTCLK}	-	9.2 @fFRM=60Hz	15	MHz	VDD=2.9~3.5V


VCYC
VSYNC
1H
VLW
VBP
VDP
VFP
HSYNC
DE
HCYC
HSYNC
1 CLK
HBP
HLW
HDP
HFP
CLK
DE
PD[23:0]
1st
480

7-3. AC characteristics

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

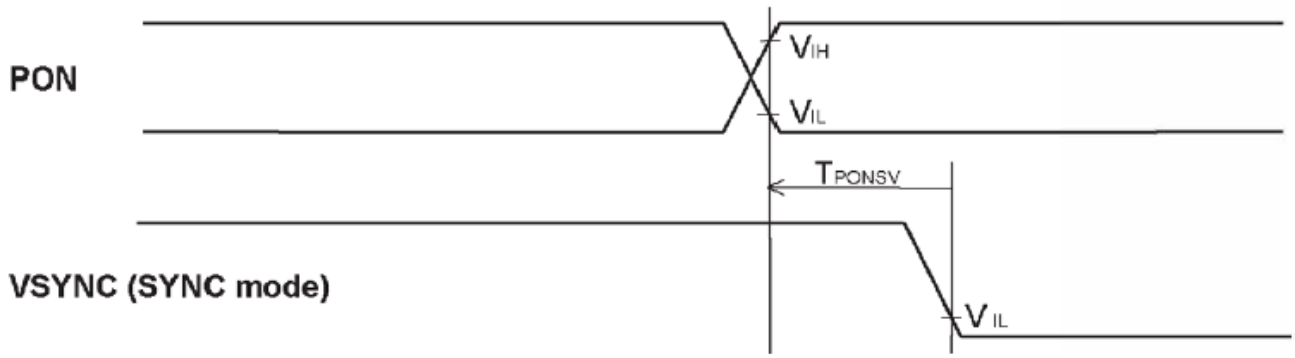
Parameter	Symbol	Min.	Typ.	Max.	Unit
VSYNC,HSYNC setup time	t_{SYNCS}	10	-	-	ns
ENABLE (DE) setup time	t_{ENS}	10	-	-	
ENABLE (DE) hold time	t_{ENH}	10	-	-	
DOTCLK "Low" level pulse width	P_{WDL}	25	-	-	
DOTCLK "High" level pulse width	P_{WDH}	25	-	-	
DOTCLK cycle time	t_{CYCD}	66.7	-	-	
Data setup time	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.

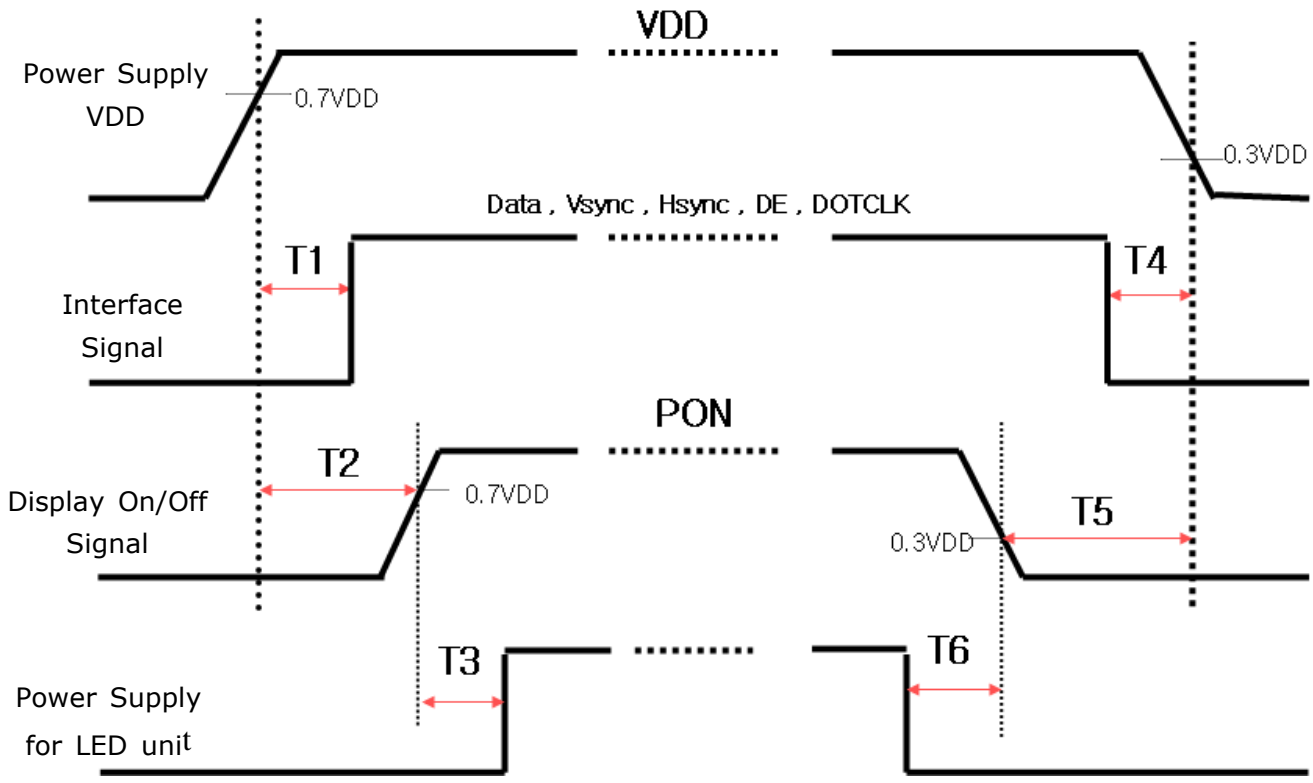
※ Operating at VDD=2.9~3.5V , Ta = -40℃~+85℃

Item	Symbol	Min.	Typ.	Max.	unit
PON setup (SYNC mode)	t_{PONSV}	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.

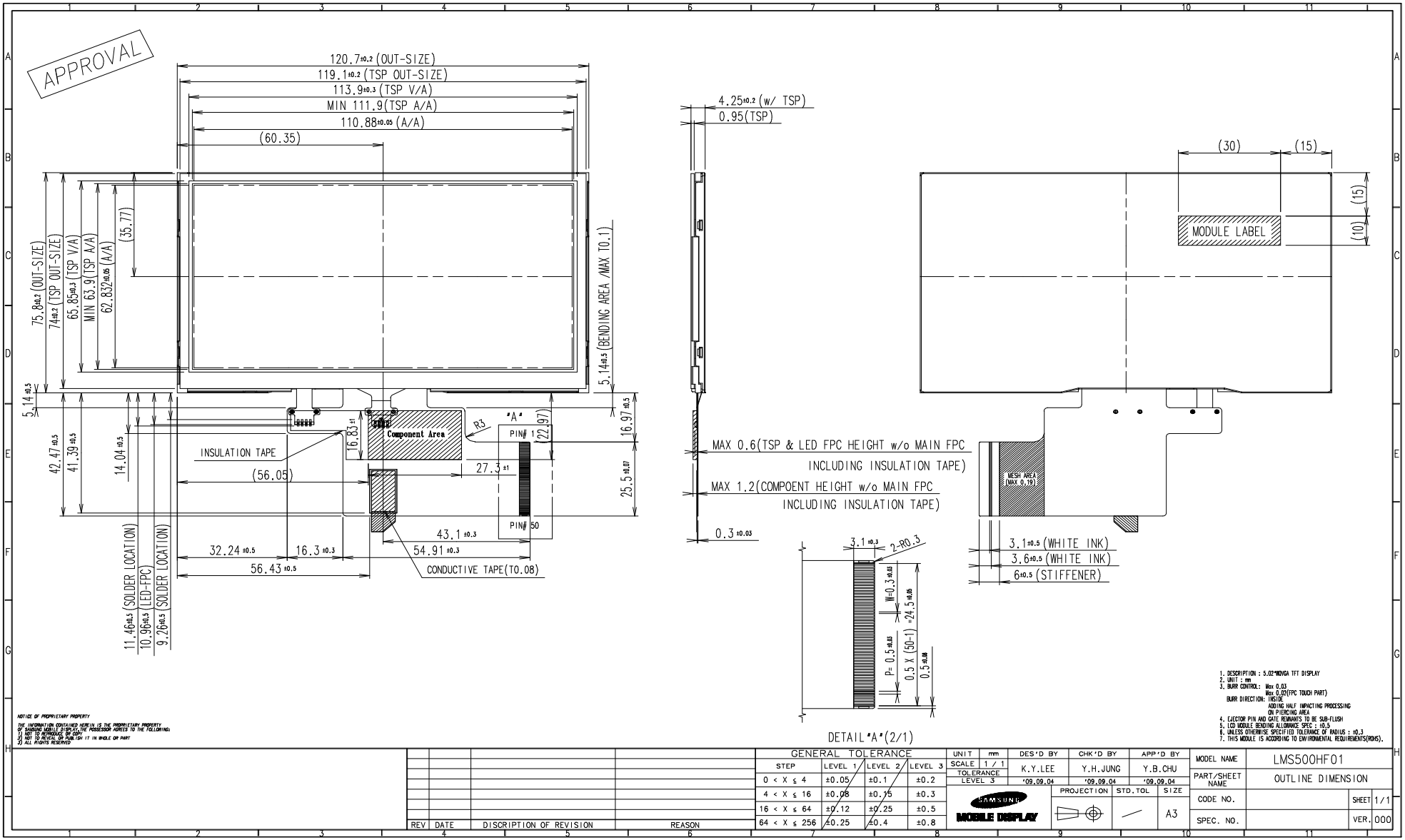


Symbol	Specification	Note
T1	0 ms < T1 < T2	
T2	10 ms < T2	(1)
T3	10 frames < T3	
T4	10 ms < T4 < T5	
T5	(6 frames + T4) < T5	(1)
T6	10 frames < T6	

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

Preliminary

9. Outline Dimension

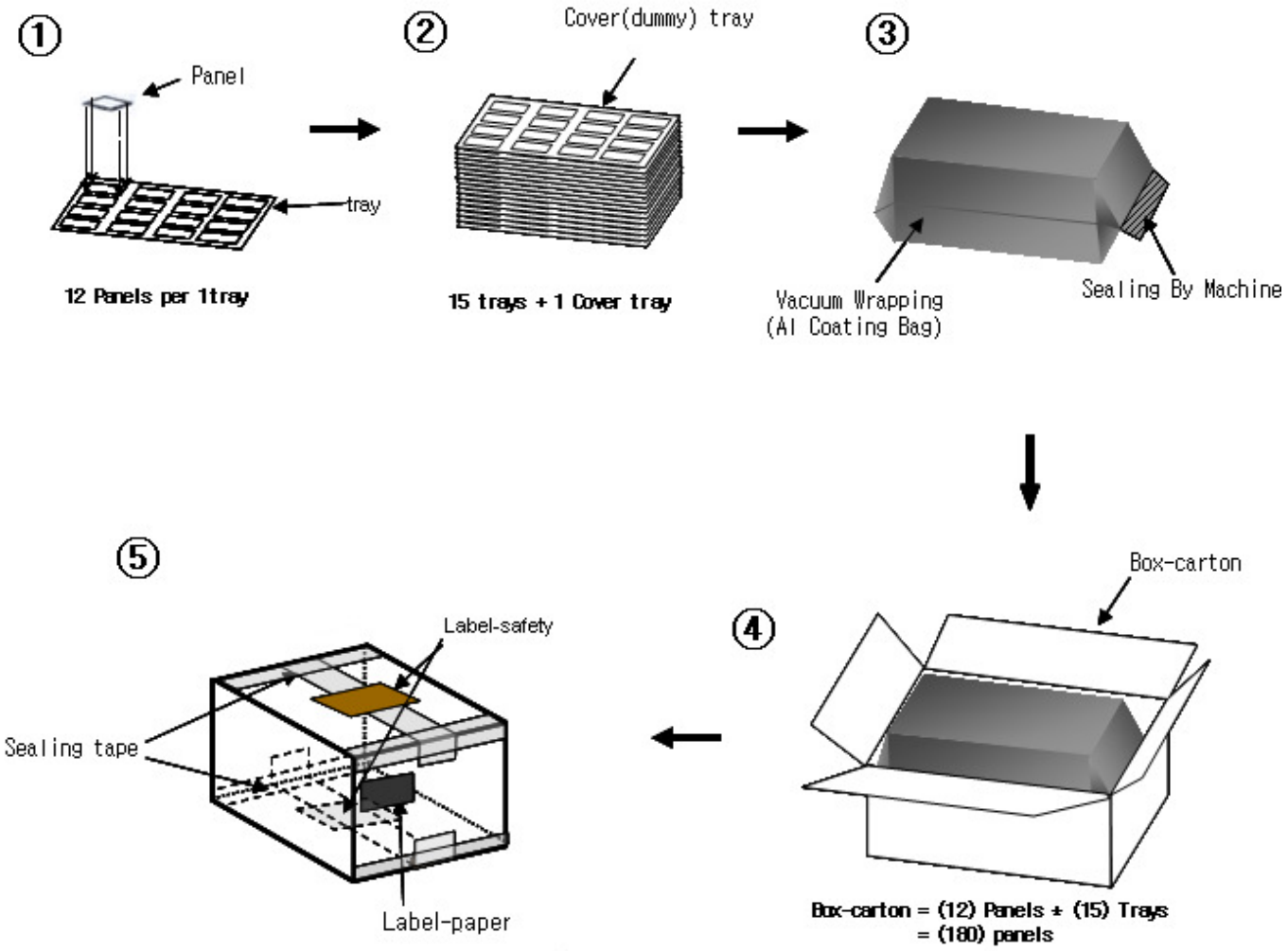


SAMSUNG CONFIDENTIAL

이상훈09484036주주개월2일20090807142043

055731252300653

10. Packing



Note

(1) Total : Box-carton approx. : 17.5Kg

(2) Size : Box : 583(W) x 388(D) x 210(H)

(3) Place the panels in the tray facing the active area direction.

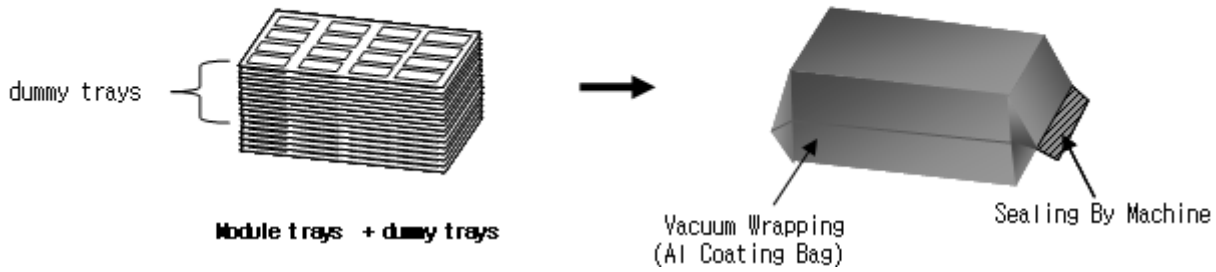
(4) Stack the trays and cover (dummy) tray.

(5) Wrap the AL coating bag by vacuum sealing machine.

(6) Put the bag in the box-carton/

(7) Seal the box-carton and affix the label-safety & label-paper.

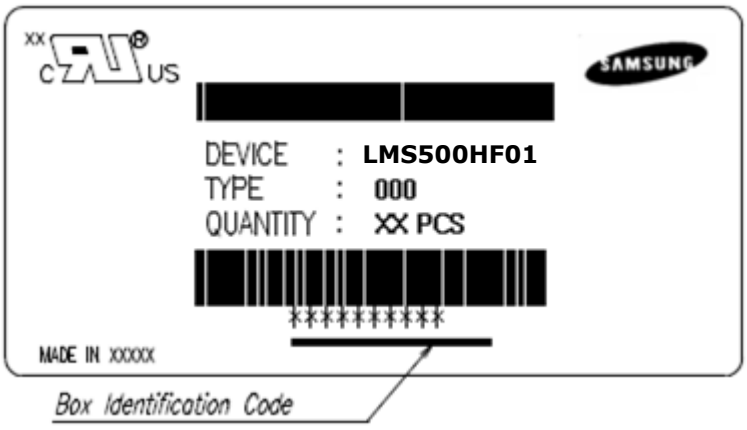
※ Packing spec. for small quantities



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



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 and TSP soldering pad.

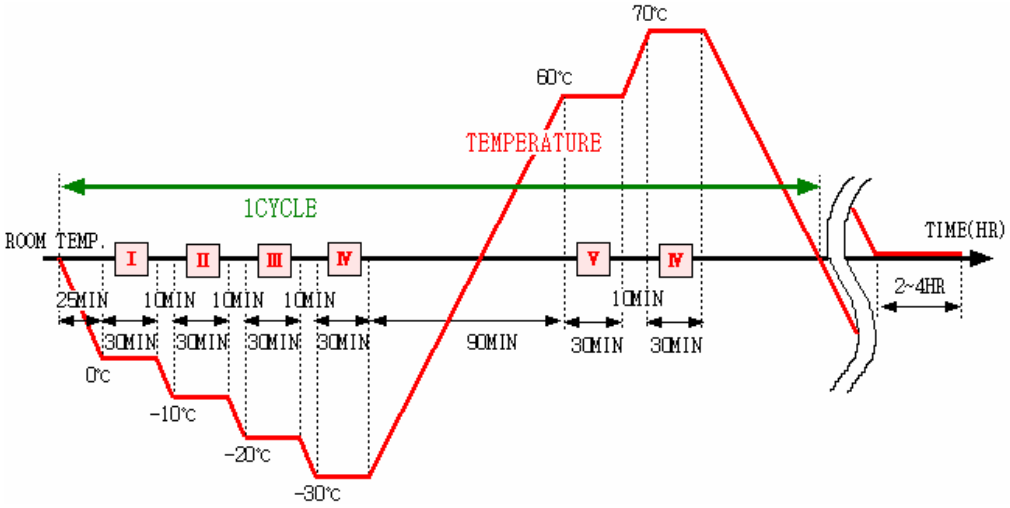
13. Reliability Test Condition

Item	Condition	Sample Size	Remark
High Temperature Operating Life test	70℃ 160HR	10EA	Note(1)
Low Temperature Operating Life test	−20℃ 160HR	5EA	
Thermal Humidity Bias	60℃ 90%RH 160HR	10EA	
On/Off Test	70℃⇔−30℃(5CYC),	10EA	Note(2)
High Temperature Storage test	85℃ 160HR	5EA	
Low Temperature Storage test	−40℃ 160HR	5EA	
Wet Humidity Temperature Storage test	60℃/90%RH 160HR	10EA	
Altitude test	Non-operating:188mb/Room Temp. 72HR	5EA	
Thermal Cycle storage test	−40～85℃, 30CYC	10EA	Note(3)
Electrical Static Discharge	Contact:±4㎸, 150㎊/330Ω Non-contact:±8㎸, 150㎊/330Ω	5EA 5EA	Note(4)
Box Vibration	Random Vibration MIN-STD 810E, up/down(Z)Axis	(1BOX Small)	Note(5)
Box Drop	1 corner, 3 edges, 6 surfaces under 9.1㎏:76㎝, 9.2~18.2kg: 66cm	(1BOX Medium)	

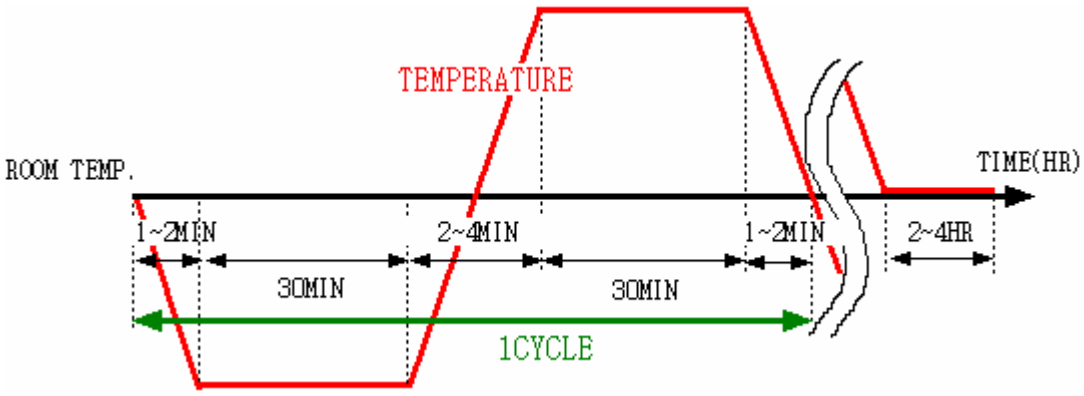
NOTE) Touch screen criteria should ultimately be judged after passing dwelling time of each reliability test and keeping 24 hours at room temperature, while other performances and characteristics are inspected 2 hours later.

Note(1) Panel surface temperature.

Note(2) ON Time over 10 seconds, OFF Time under 10 seconds.



Note(3) STORAGE



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

Note(5) 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	-	-