Preliminary

Product Information

DATE : April. 26. 2007

SAMSUNG TFT-LCD

MODEL NO : LMS250GF04-001

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 : AMLCD Mobile Display Development

LCD Business

Samsung Electronics Co. , LTD.

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Revision History

Preliminary

Data	Rev. No.	Page	Summary
April. 26. 2007	000		Rev.000 was first issued.

General Description

* Description

LMS250GF04-001 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 2.5" contains 960 x 240 dots and can display up to 262,144 colors.

* Features

- Transmissive with Micro Reflective type and back-light with 3 LEDs.
- TN mode (Normally White).
- Wide Viewing Angle.
- Stripe Pixel structure.
- 18bit RGB parallel Interface + Serial Peripheral Interface (SPI)
- Gate Driver IC embeded on Panel
- Low Power consumption.

* Applications

- Display terminals for HHP, MP3, PMP application products.

* **General information**

Items	Specification	Unit	Note
Display Area	50.88(H) x 38.16(V)	mm	-
Driver Element	a-Si TFT active matrix	-	-
Display Colors	262k	color	-
Number of Pixels	320(H) x 240(V)	pixel	-
Pixel Arrangement	Stripe Structure	-	-
Pixel Pitch	0.159(H) x 0.159(V)	mm	-
Display Mode	Normally White	-	-
Gray Inversion Angle	12	o'clock	-
Surface Treatment	2H	-	-

* **Mechanical information**

Item		Min.	Typ.	Max.	Unit	Note
Module size	Horizontal(H)	55.73	55.88	56.03	mm	(1)
	Vertical(V)	47.81	47.96	48.11	mm	(1)
	Depth(D)	2.25	2.4	2.55	mm	(1)
Weight		-	TBD	-	g	(2)

Note (1) : Not include FPC

Note (2) : Included FPC

1. Absolute Maximum Ratings

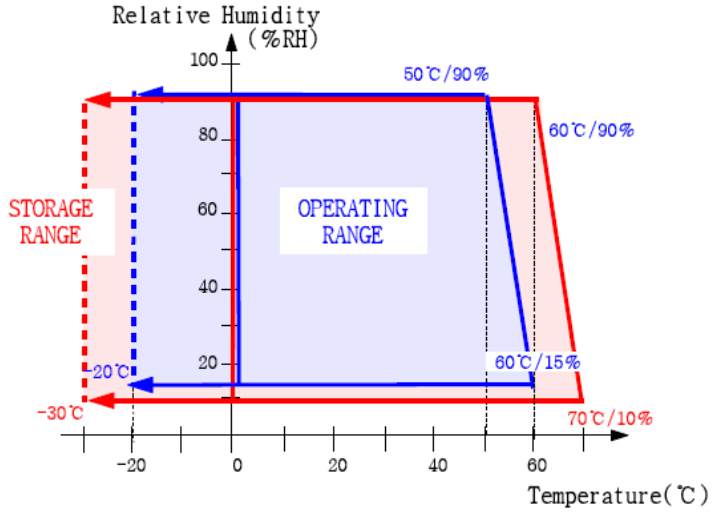
1.1 Absolute Ratings of Environment

Item	Symbol	Min.	Max.	Unit	Note
Storage temperature	T_{STG}	-30	70	℃	(1)
Operating temperature (Ambient temperature)	T_{OPR}	-20	60	℃	(1),(2)

Note (1) 90 % RH Max. (50°C ³ Ta)

Maximum wet-bulb temperature at 49°C or less. (Ta > 50°C)

No condensation.



Temperature & Humidity Graph at Absolute Environment

(2) In case of below 0°, the response time of liquid crystal (LC) becomes slower and the color of panel becomes darker than normal one. Level of retardation depends on temperature, because of LC's characteristics.

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

1.2 Electrical Absolute Ratings

(1) TFT-LCD Module

(Ta = 25°C ± 2°C, GND=0V)

Characteristics	Symbol	Min.	Max.	Unit	Note
Logic Input Voltage	VDD3	-0.3	5.0	V	(1)
Analog Input Voltage	VCI	-0.3	5.0	V	(1)

(2) Back-Light Unit

(Ta = 25 ± 2°C)

Item	Symbol	Min.	Max.	Unit.	Note
Current	I_B	-	30	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: SR-3, BM-7, EZ-Contrast

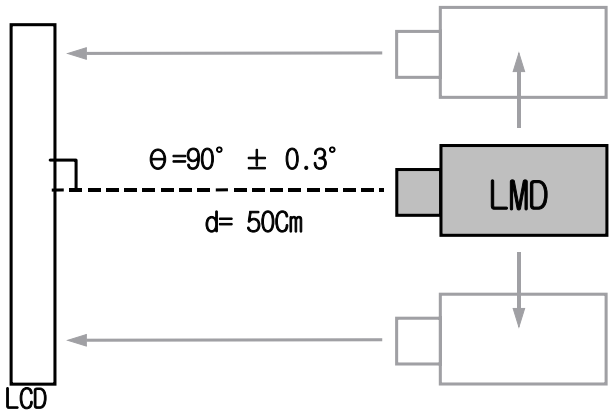
(Ta = 25 ± 2°C, VDD3 = VCI = 3.0V, I_B = 25mA)

Item		Symbol	Condition	Min.	Typ.	Max.	Unit	Note
Contrast ratio (Center point)		C/R	Note (1),(6) Φ = 0 Θ = 0 Normal Viewing Angle B/L On	-	(300)	-	-	(2) SR-3
Luminance of white (Center point)		Y_L		-	(330)	-	cd/m²	(3) SR-3
Response time	Rising: Tr	Tr+Tf		-	(25)	(35)	msec	(4) BM-7
	Falling: Tf							
Color chromaticity (CIE 1931)	White	Wx		TBD			-	(5) SR-3
		Wy						
	Red	Rx						
		Ry						
	Green	Gx						
		Gy						
	Blue	Bx						
		By						
Viewing angle	Hor.	ΘL	C/R≥10 B/L On	-	(70)	-	Degrees	(6) Ez - Contrast
		ΘR		-	(70)	-		
	Ver.	ΦH		-	(60)	-		
		ΦL		-	(50)	-		

Note (1) Test Equipment Setup

After stabilizing and leaving the panel alone at a given temperature for 30 min, the measurement should be executed. Measurement should be executed in a stable, windless, and dark room. 30 min after lighting the back-light. This should be measured in the center of screen.

- **Environment condition : Ta = 25 ± 2 °C**
- **Back-Light On condition**



LMD : Ligh Mesurement Devices

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

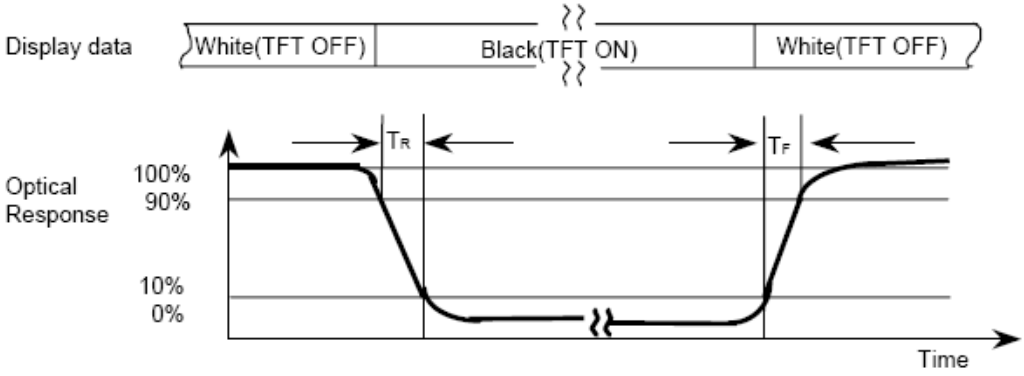
$$CR = \frac{G\ max}{G\ min}$$

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

Note (3) Definition of Luminance of White (YL)

: Luminance of white at the center point

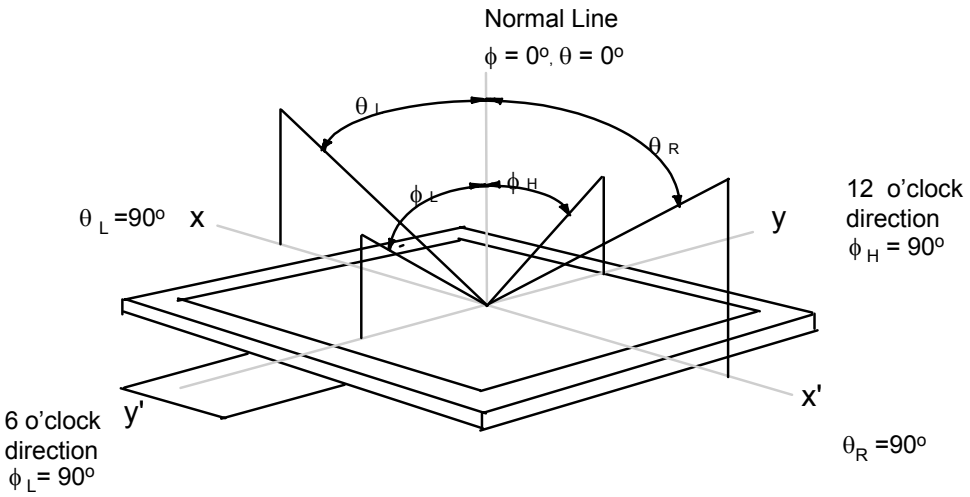
Note (4) Definition of Response time : Sum of Tr and Tf (Field : 1°)



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≥10)



3. Electrical Characteristics

3.1 TFT-LCD Module

Ta = 25 ± 2°C

Characteristics	Symbol	Min.	Typ.	Max.	Unit	Note
Logic Input Voltage	VDD	2.7	3.0	3.3	V	-
Analog Input Voltage	VCI	2.7	3.0	3.3	V	-
Power Dissipation	P_{FULL}	-	TBD	-	mW	(1),(2)
Frame frequency	f_{Frame}	-	90	-	Hz	-
Dot Clock	DCK	-	-	10	MHz	-
Serial Clock	XSCK	-	-	18	MHz	-

* To prevent a latch-up or DC operation of the LCD module, the power on/off sequence should be as the Chapter 10. Power On/Off Sequence.

Note (1) VDD3 = VCI = 3.0V f_{Frame} = 90 Hz
(2) Dissipation current check pattern

▶ Black pattern

3.2 Back-Light unit

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

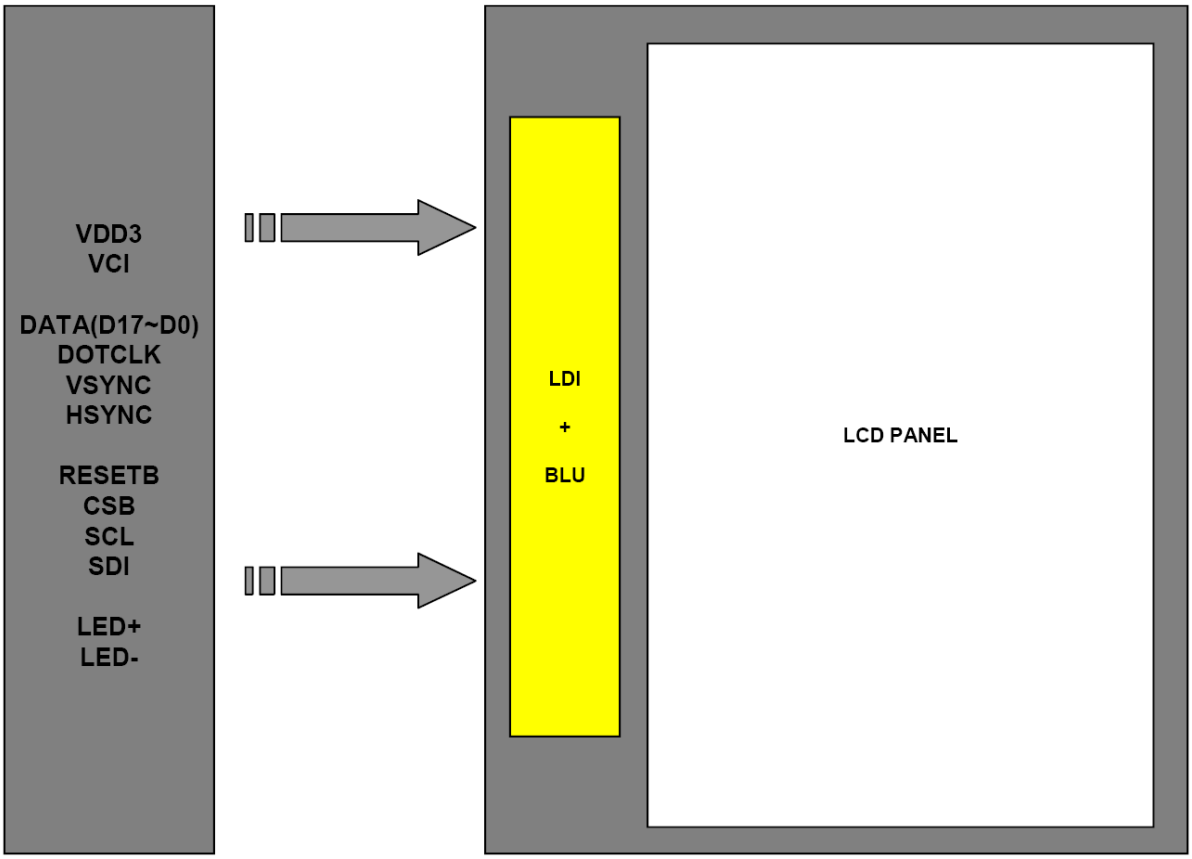
(Ta=25 ± 2°C)

Item	Symbol	Min.	Typ.	Max.	Unit	Note
Current	I_B	-	25	-	mA	(1)
Power Consumption	P_{BL}	-	TBD	-	mW	-

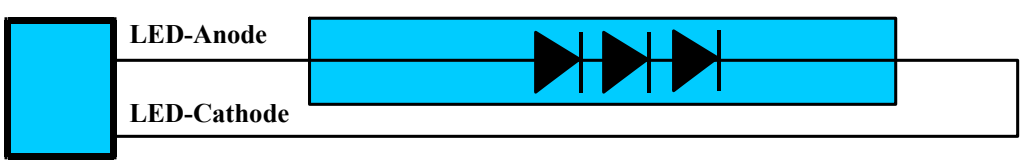
Note (1) Three LEDs serial type.

4. Block Diagram

4.1 TFT-LCD Module (Interface System Structure)



4.2 Back Light Unit



5. Input Terminal Pin Assignment

5.1 Input Signal & Power (Connector : Hirose FH23 series, 39Pin, 0.3mm Pitch)

Pin No	Symbol	Description	I/O	Pin No	Symbol	Description	I/O
1	LED-	LED Cathode	I	21	D12	RED0 (LSB)	I
2	NC	Not Connection	-	22	D11	GREEN5 (MSB)	I
3	LED+	LED Anode	I	23	D10	GREEN4	I
4	NC	Not Connection	-	24	D9	GREEN3	I
5	VCI	Analog Input Voltage (typ 3.0V)	I	25	D8	GREEN2	I
6				26	D7	GREEN1	I
7				27	D6	GREEN0 (LSB)	I
8	GND	Ground	I	28	D5	BLUE5 (MSB)	I
9	VDD3	Logic Input Voltage (typ 3.0V)	I	29	D4	BLUE4	I
10				30	D3	BLUE3	I
11	VSYNC	Vsync	I	31	D2	BLUE2	I
12	HSYNC	Hsync	I	32	D1	BLUE1	I
13	GND	Ground	I	33	D0	BLUE0 (LSB)	I
14	DOTCLK	Dotclk	I	34	GND	Ground	I
15	GND	Ground	I	35	SCL	Serial Clock	I
16	D17	RED5 (MSB)	I	36	CSB	Chip Select	I
17	D16	RED4	I	37	SDI	Serial Data Input	I
18	D15	RED3	I	38	RESETB	RESETB	I
19	D14	RED2	I	39	GND	Ground	I
20	D13	RED1	I				

5.2 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	G0	G1	G2	G3	G4	G5	B0	B1	B2	B3	B4	B5	
BASIC COLOR	BLACK	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	1	1	1	1	1	1	-
	GREEN	0	0	0	0	0	0	1	1	1	1	1	1	0	0	0	0	0	0	-
	CYAN	0	0	0	0	0	0	1	1	1	1	1	1	1	1	1	1	1	1	-
	RED	1	1	1	1	1	1	0	0	0	0	0	0	0	0	0	0	0	0	-
	MAGENTA	1	1	1	1	1	1	0	0	0	0	0	0	1	1	1	1	1	1	-
	YELLOW	1	1	1	1	1	1	1	1	1	1	1	1	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	-
GRAY SCALE OF RED	BLACK	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	R1
		0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	R2
		:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	R3~R60
	↓ LIGHT	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	
		1	0	1	1	1	1	0	0	0	0	0	0	0	0	0	0	0	0	R61
		0	1	1	1	1	1	0	0	0	0	0	0	0	0	0	0	0	0	R62
	RED	1	1	1	1	1	1	0	0	0	0	0	0	0	0	0	0	0	0	R63
GRAY SCALE OF GREEN	BLACK	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	1	0	0	0	0	0	0	0	0	0	0	0	G1
		0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	G2
		:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	G3~G60
	↓ LIGHT	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	
		0	0	0	0	0	0	1	0	1	1	1	1	0	0	0	0	0	0	G61
		0	0	0	0	0	0	0	1	1	1	1	1	0	0	0	0	0	0	G62
	GREEN	0	0	0	0	0	0	1	1	1	1	1	1	0	0	0	0	0	0	G63
GRAY SCALE OF BLUE	BLACK	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	B0
	DARK ↑	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	B1
		0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	B2
		:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	B3~B60
	↓ LIGHT	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	
		0	0	0	0	0	0	0	0	0	0	0	0	1	0	1	1	1	1	B61
		0	0	0	0	0	0	0	0	0	0	0	0	0	1	1	1	1	1	B62
	BLUE	0	0	0	0	0	0	0	0	0	0	0	0	1	1	1	1	1	1	B63

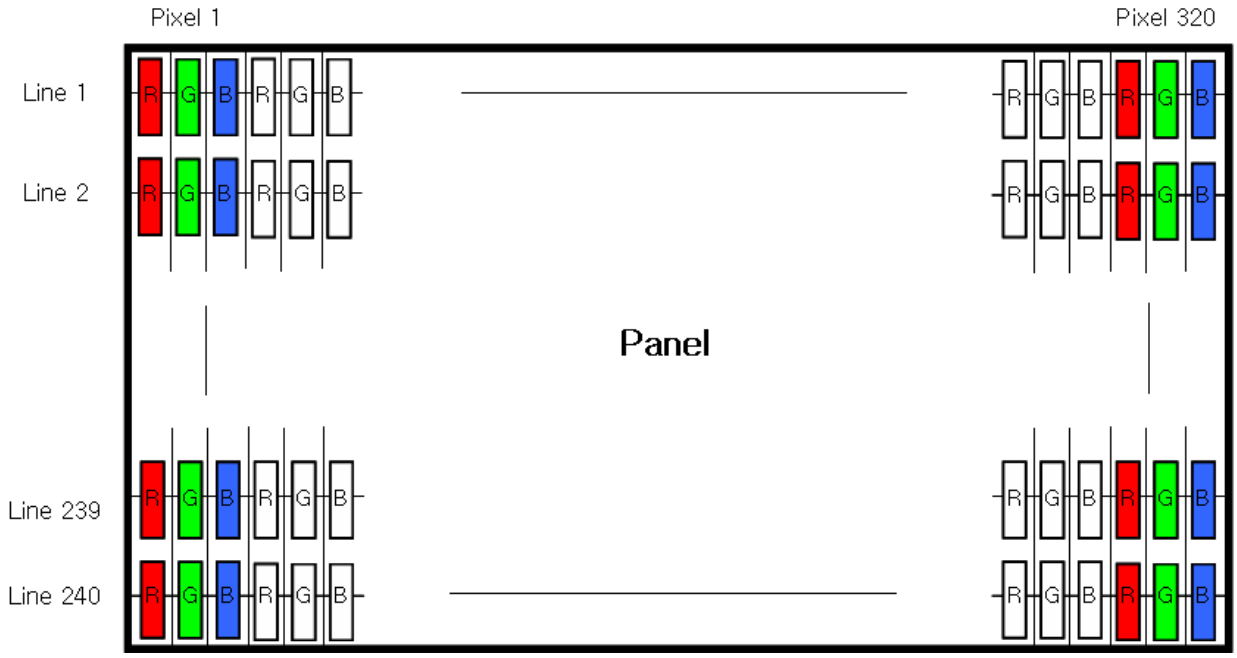
Note) Definition of Gray :

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

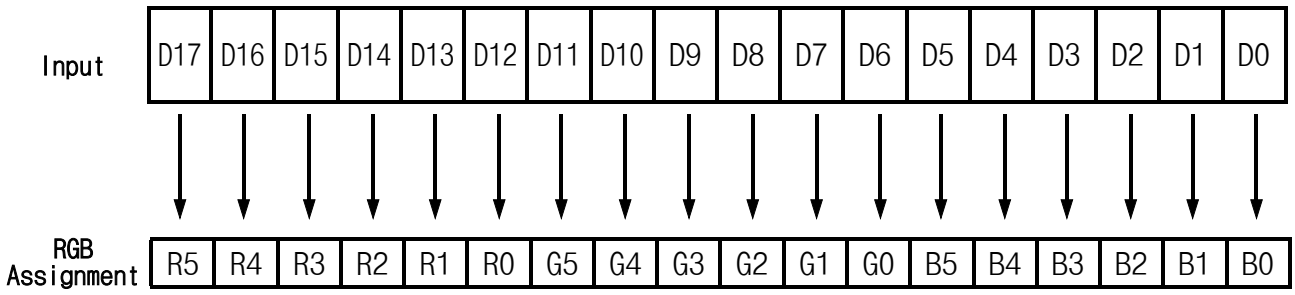
Input Signal : 0 = Low level voltage, 1 = High level voltage

6. Operation Specifications

6.1 Pixel Formation (Stripe Pixel Structure)

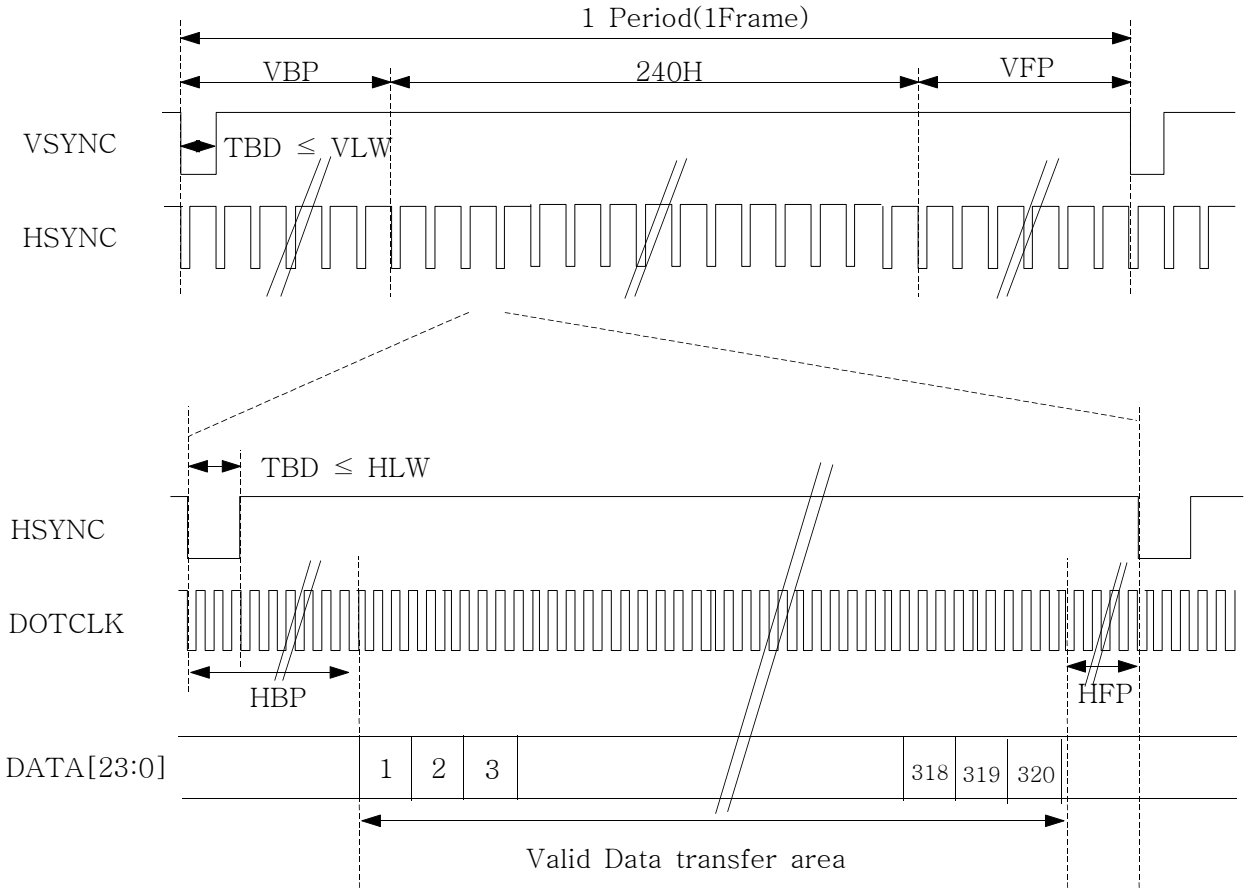


6.2 Data Format for 18bit RGB Interface



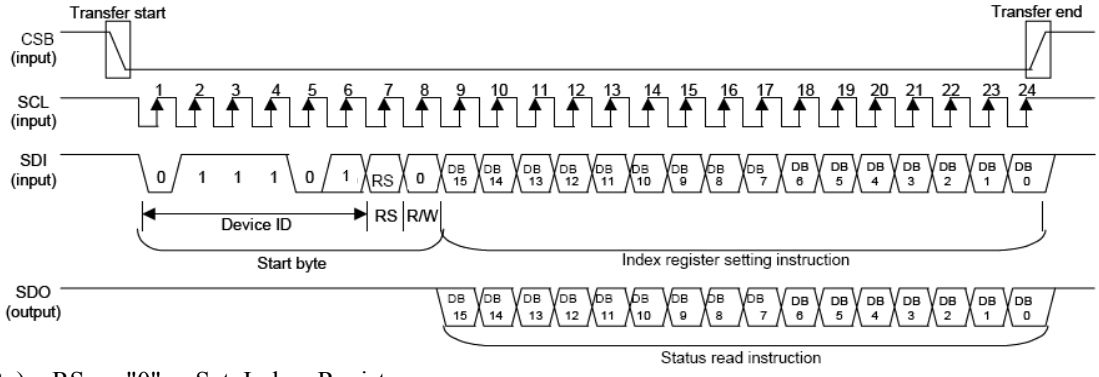
7. Interface Timing

7.1 18bit RGB Interface Timing



* TBD ≥ VBP ≥ TBD , VBP > VLW , VFP ≥ TBD
* TBD ≥ HBP ≥ TBD , HBP > HLW , HFP ≥ TBD

7.2 Serial Peripheral Interface

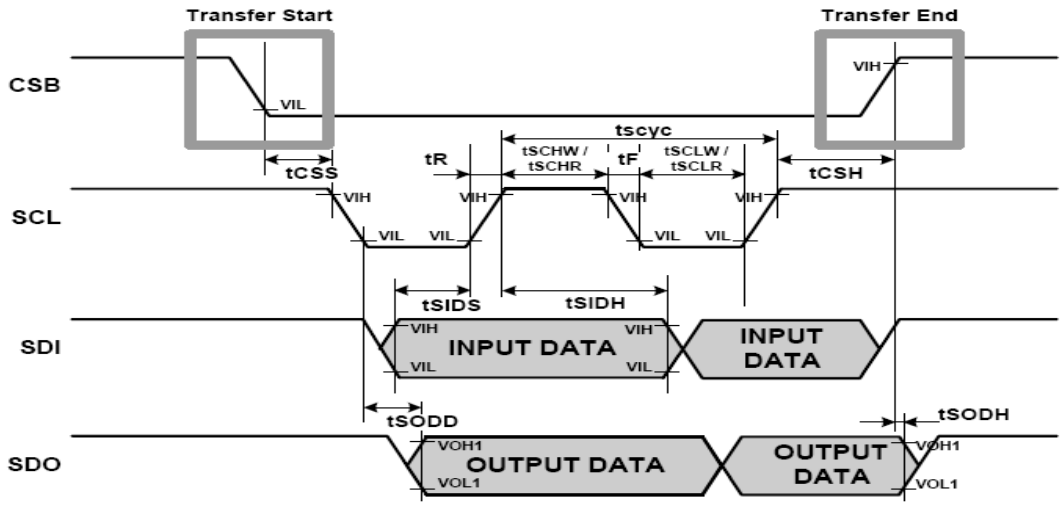


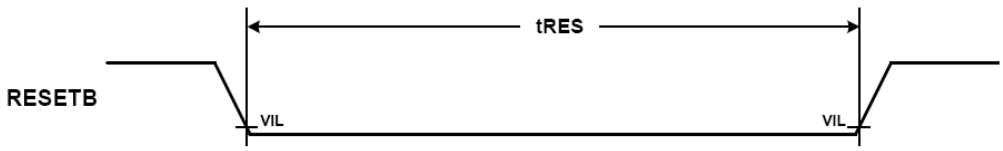
Note) RS = "0" : Set Index Register
RS = "1" : Write Instruction

8. Electrical Specifications

VDD3 = 3.0V, Ta = 25℃ ± 2℃

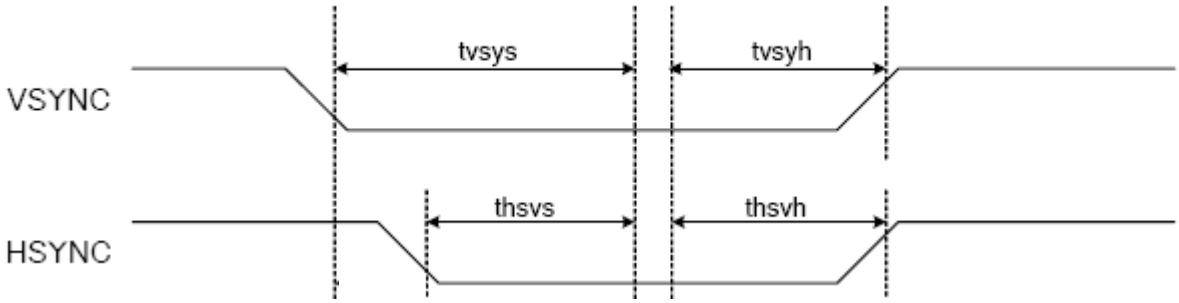
Item	Symbol	Min.	Max.	Unit
Serial Clock Cycle Time	tSCYC	100	-	ns
Serial Clock rise/fall time	tR,tF	-	10	
Pulse width high for write	tSCHW	30	-	
Pulse width low for write	tSCLW	50	-	
Chip Select Setup Time	tCSS	20	-	
Chip Select Hold Time	tCSH	90	-	
Serial Input Data Setup Time	tSIDS	30	-	
Serial Input Data Hold Time	tSIDH	30	-	
Serial Output Data delay Time	tSODD	-	200	
Serial Output Data Hold Time	tSODH	5	-	
Reset Low Pulse Width	tRES	30	-	us
CSB Low Pulse Width for Wake up	tCSBR	12	-	

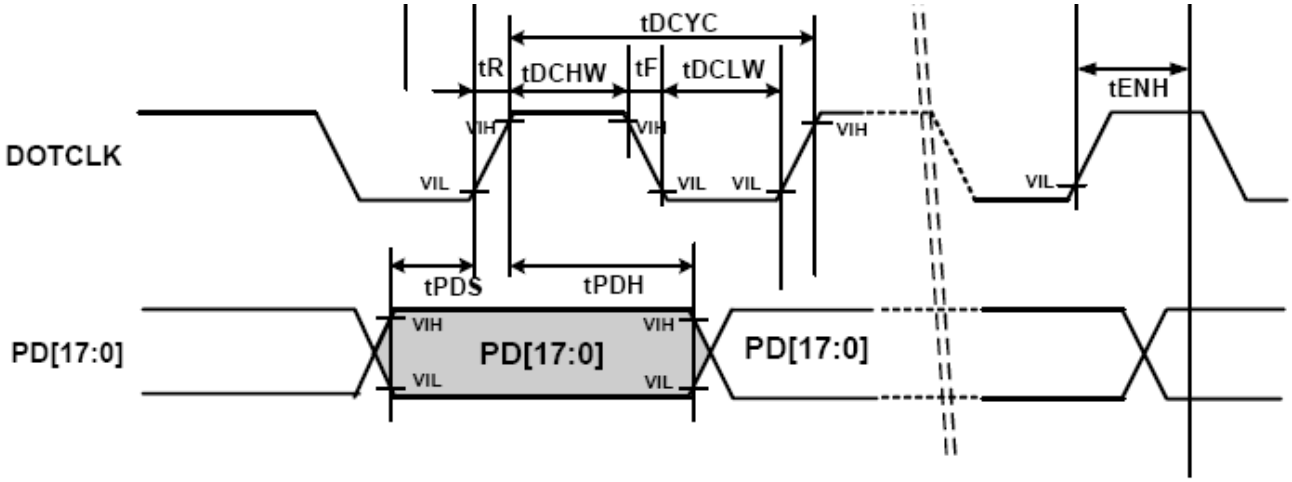




VDD3 = 3.0V, Ta = 25℃ ± 2℃

Item	Symbol	Min.	Max.	Unit
Vsync/Hsync Setup Time	Tvsys Thsvs	20	-	ns
Vsync/Hsync Hold Time	Tvsyh Thsyh	20	-	
Dotclk Low Level Pulse Width	tDCLW	50	-	
Dotclk High Level Pulse Width	tDCHW	50	-	
Dotclk Cycle Time	tDCYC	100	-	
PD(Data) Setup Time	tPDS	40	-	
PD(Data) Hold Time	tPDH	40	-	
Dotclk Rise/Fall Time	tR, tF	-	10	





9. Power On/Off Sequence (TBD)

9.1 Power On Sequence

System Power On	System Power On wait more than 1frame Reset more than 1ms
Power Setting Sequence	R07=0000 wait more than 10ms R12h=1618h R11h=2227h R13h=6560h R10h=510Ch wait 6 frame or more R12h=1658h wait more than 5 frame
Initializing Sequence	R01h=2B1D R02h=0300h R03h=C040h (Note 1) R08h=0008h(Note 2) R09h=000Ah(Note 3) R76h=2213h R0Bh=33E1h R0Ch=0024h R76h=0000h R0Dh=0000h R0Eh=0000h R14h=0000h R15h=0803h R16h=000Bh R30h=0201h R31h=0A06h R32h=0C07h R33h=0002h R34h=070Ch R35h=060Ah R36h=0102h R37h=0200h R38h=0008h R39h=0800h

Display On Sequence	R07h=0001h wait 2 frame or more R07h=0101h wait 2frame or more R76h=2213h R1Ch=6650h R0Bh=33E1h R76h=0000h R07h=0103h

9.2 Power Off Sequence

Display Off Sequence	R0Bh=30E1h R07h=0102h wait 2frame or more R07h=0000h R12h=0000h R10h=0100h

9.3 Standby In / Out Sequence

Standby In Sequence	Display On Status Display off Sequence R10h=0001h

Standby Out Sequence	Standby In Status R10h=0000h Power Setting Sequence Display On Sequence

Note 1) Polarity Setting

DB15	DB14	DB13	DB12	DB11	DB10	DB9	DB8	DB7	DB6	DB5	DB4	DB3	DB2	DB1	DB0
VPL	HPL	DPL	1	0	0	0	0	0	1	0	0	0	0	0	0

* VPL : Vsync Polarity (0 : High Active, 1 : Low Active)
* HPL : Hsync Polarity (0 : High Active, 1 : Low Active)
* DPL : Dotclk Polarity (0 : Data fetched at falling edge, 1 : at rising edge)

Note 2) VBP (Vsync Back Porch)

DB15	DB14	DB13	DB12	DB11	DB10	DB9	DB8	DB7	DB6	DB5	DB4	DB3	DB2	DB1	DB0
0	0	0	0	0	0	0	0	VBP7	VBP6	VBP5	VBP4	VBP3	VBP2	VBP1	VBP0

VBP 7	VBP 6	VBP 5	VBP 4	VBP 3	VBP 2	VBP 1	VBP 0	Number of Raster Periods In the Back Porch
0	0	0	0	0	0	0	0	3
0	0	0	0	0	0	0	1	3
0	0	0	0	0	0	1	0	4
0	0	0	0	0	0	1	1	5
0	0	0	0	0	1	0	0	6
				.				.
				.				.
				.				.
1	1	1	1	1	1	0	0	254
1	1	1	1	1	1	0	1	255
1	1	1	1	1	1	1	0	256
1	1	1	1	1	1	1	1	257

* The porch period should meet the following condition.

257H ≥ VBP ≥ 3H , VBP > VLW

Note 3) HBP (Hsync Back Porch)

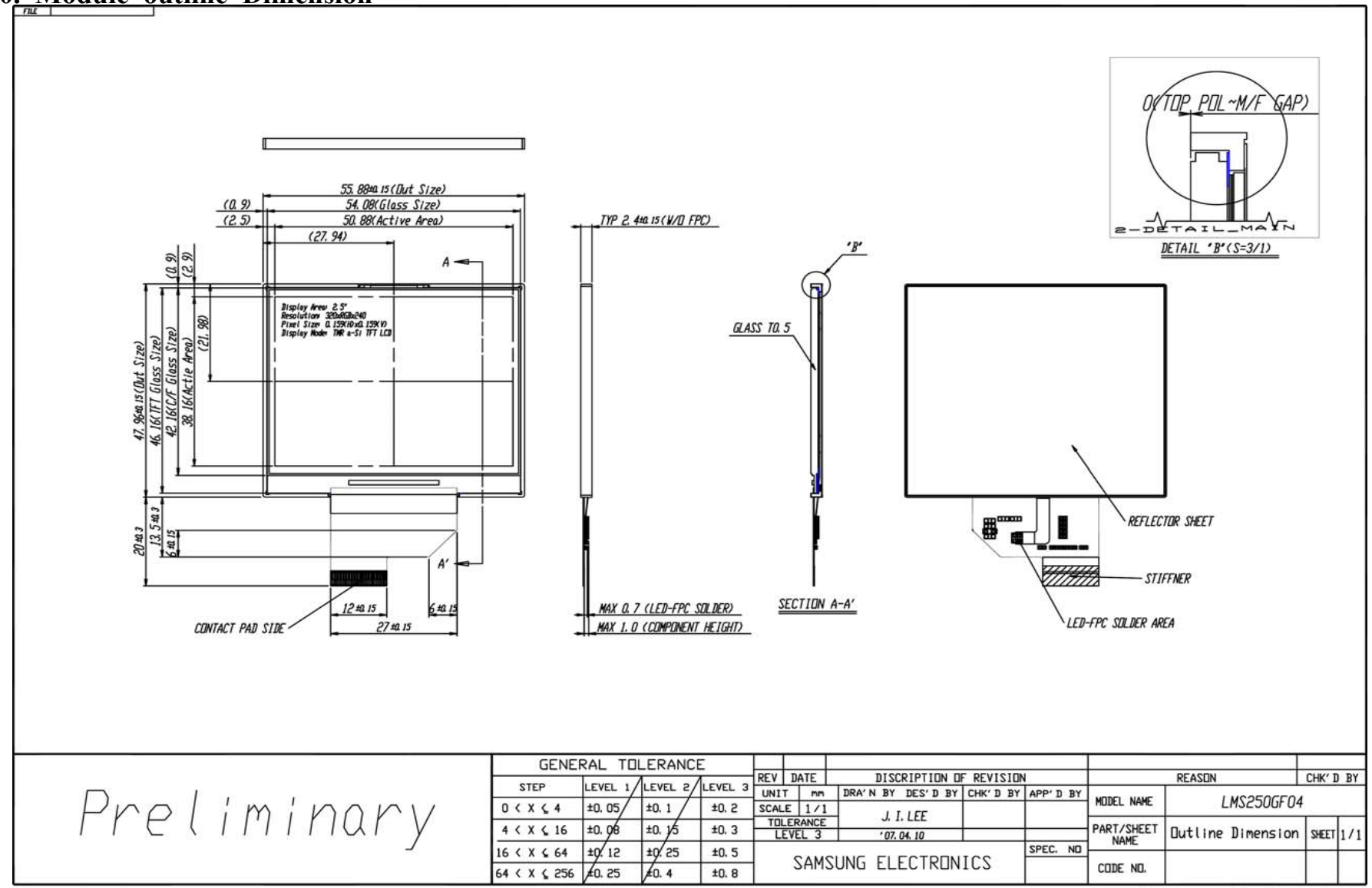
DB15	DB14	DB13	DB12	DB11	DB10	DB9	DB8	DB7	DB6	DB5	DB4	DB3	DB2	DB1	DB0
0	0	0	0	0	0	0	HBP8	HBP7	HBP6	HBP5	HBP4	HBP3	HBP2	HBP1	HBP0

HBP 8	HBP 7	HBP 6	HBP 5	HBP 4	HBP 3	HBP 2	HBP 1	HBP 0	Number of MCLKs In the Back Porch 24 bit (8 bit)
0	0	0	0	0	0	0	0	0	8 (24)
0	0	0	0	0	0	0	0	1	8 (24)
0	0	0	0	0	0	0	1	0	8 (24)
0	0	0	0	0	0	0	1	1	8 (24)
0	0	0	0	0	0	1	0	0	8 (24)
0	0	0	0	0	0	1	0	1	8 (24)
0	0	0	0	0	0	1	1	0	8 (24)
0	0	0	0	0	0	1	1	1	8 (24)
0	0	0	0	0	1	0	0	0	8 (24)
0	0	0	0	0	1	0	0	1	9 (27)
0	0	0	0	0	1	0	1	0	10 (30)
0	0	0	0	0	1	0	1	1	11 (33)
				.					
				.					
				.					
1	1	1	1	1	1	1	0	1	509 (1527)
1	1	1	1	1	1	1	1	0	510 (1530)
1	1	1	1	1	1	1	1	1	511 (1533)

* The porch period should meet the following condition.

1533dck ≥ HBP ≥ 24dck , HBP > HLW

10. Module outline Dimension



Preliminary

GENERAL TOLERANCE			
STEP	LEVEL 1	LEVEL 2	LEVEL 3
0 < X ≤ 4	±0.05	±0.1	±0.2
4 < X ≤ 16	±0.08	±0.15	±0.3
16 < X ≤ 64	±0.12	±0.25	±0.5
64 < X ≤ 256	±0.25	±0.4	±0.8

REV	DATE	DISCRIPTION OF REVISION				REASON	CHK'D BY
UNIT	mm	DRA'N BY	DES'D BY	CHK'D BY	APP'D BY	MODEL NAME	LMS250GF04
SCALE	1/1	J. I. LEE					
TOLERANCE LEVEL 3		'07.04.10				PART/SHEET NAME	Outline Dimension SHEET 1/1
SAMSUNG ELECTRONICS					SPEC. NO	CODE NO.	

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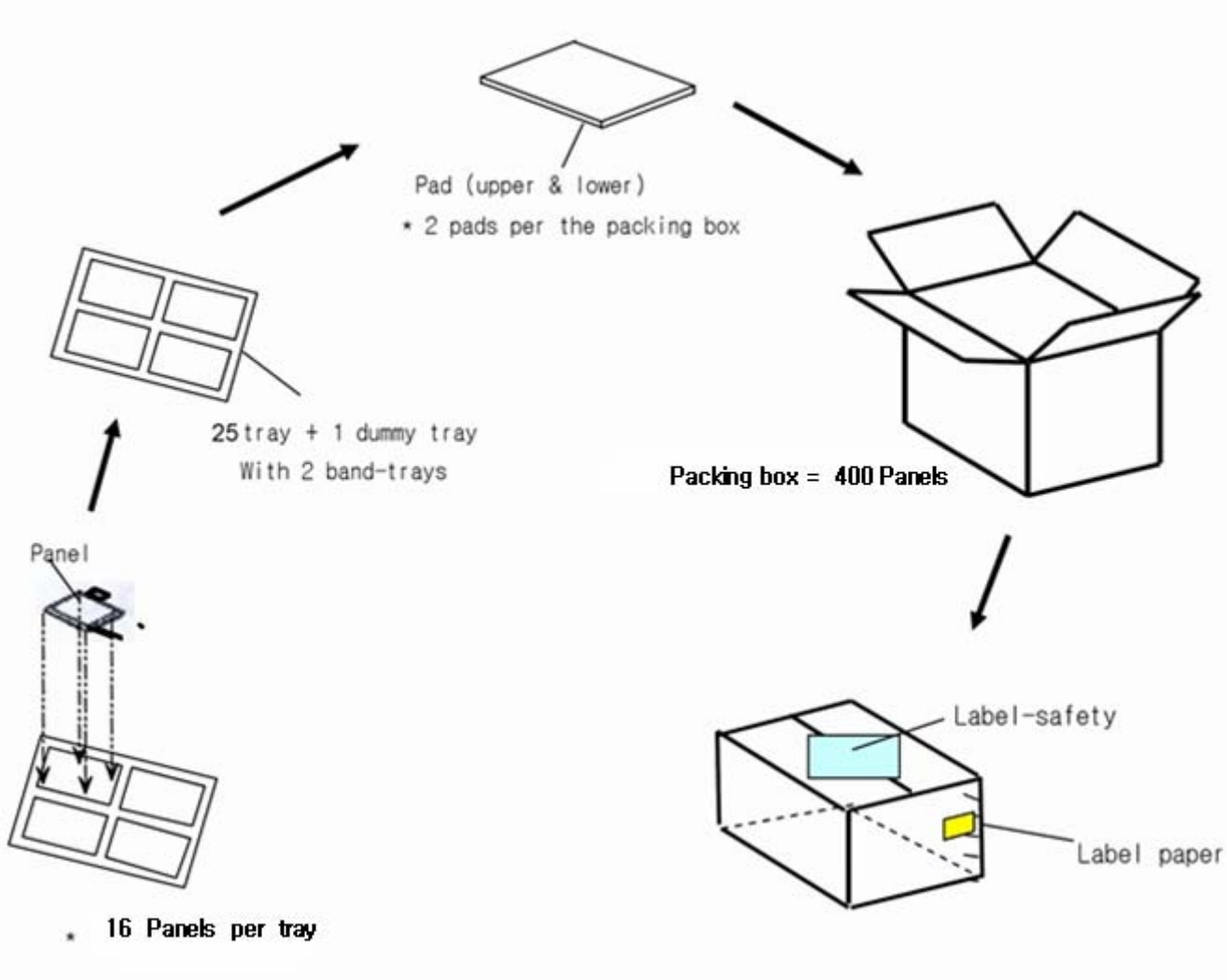
11. Packing



Note (1) Packing Box Weight : Approx. TBD Kg

(2) Packing Box Size : 505(W) x 355(D) x 208(H)

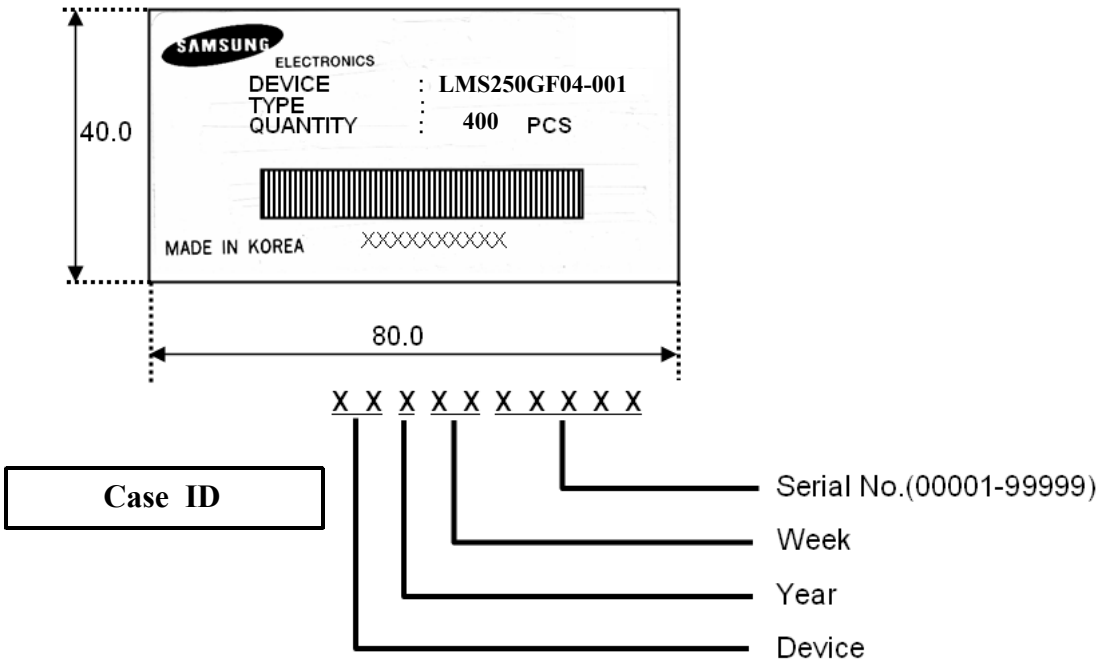
(3) Place the panels in the tray facing the direction shown in the figure.

(4) Place 25 tray and 1 cover tray and 2 pads inside the packing-box

(5) Affix the label-safety, label-paper.

12. Marking & Others

(1) Packing case attach



13. General Precautions

13.1 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) Protection film for polarizer on the module shall be slowly peeled off just before use so that the electrostatic charge can be minimized.

(l) Pins of I/F connector shall not be touched directly with bare hands

13.2 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.

13.3 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"

13.4 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.