



**Samsung Secret**

Product Information

**DATE : 03. May. 2010**

**SAMSUNG TFT-LCD**

**MODEL : LTA550HQ06**

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

APPROVAED BY 	DATE 03. May, 2010	PREPARED BY <i>Jeong-Geun Han</i>	DATE 03. May, 2010
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LCD Business

Samsung Electronics Co . , LTD.

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## General Description

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### Description

**LTA550HQ06** 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 55.0" is 1920 x 1080 and this model can display up to 1.07 Billion colors with wide viewing angle of 89° or higher in all directions. This panel is intended to support applications to provide a excellent performance for Flat Panel Display such as Home-alone Multimedia TFT-LCD TV and High Definition TV

### Features

- RoHS compliance (Pb-free)
- High contrast ratio & aperture ratio
- SPVA(Super Patterned Vertical Align) mode
- Wide viewing angle ( $\pm 178^\circ$ )
- High speed response (240Hz) & 3D Display
- FHD resolution (16:9)
- Low Power consumption
- Edge Type LED (Light Emitted Diode) BLU
- DE (Data Enable) mode
- 2ch LVDS (Low Voltage Differential Signaling) interface (2pixel/clock)

### General Information

Items	Specification	Unit	Note
Module Size	1267.6 (H <sub>TYP</sub> ) X 744.4 (V <sub>TYP</sub> )	mm	± 1.0mm
	28.9 (D <sub>TYP</sub> )		
Weight	15,000 (Max)	g	
Pixel Pitch	0.630(H) x 0.630(W)	mm	
Active Display Area	1209.6(H) X 680.4(V)	mm	
Surface Treatment	Antiglare, Hard-coating(3H)		
Display Colors	1.07 Billion	colors	
Number of Pixels	1920 x 1080	pixel	
Pixel Arrangement	RGB vertical stripe		
Display Mode	Normally Black		
Luminance of White	450 (Typ.)	cd/m <sup>2</sup>	

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## 1. Absolute Maximum Ratings

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

Item	Symbol	Min.	Max.	Unit	Note
Power Supply Voltage	$V_{DD}$	GND-0.5	13.2	V	(1)
Dimming Control	Max. Lum	-	5	V	
Storage temperature	$T_{STG}$	-20	60	°C	(2)
Operating temperature	$T_{OPR}$	0	50	°C	
Surface temperature	$T_{SUR}$	0	60	°C	(3)
Shock ( non - operating )	X,Y,Z	-	30	G	(4)
Vibration ( non - operating )	$V_{NOP}$	-	1.5	G	(5)

Note (1)  $T_a = 25 \pm 2$  °C

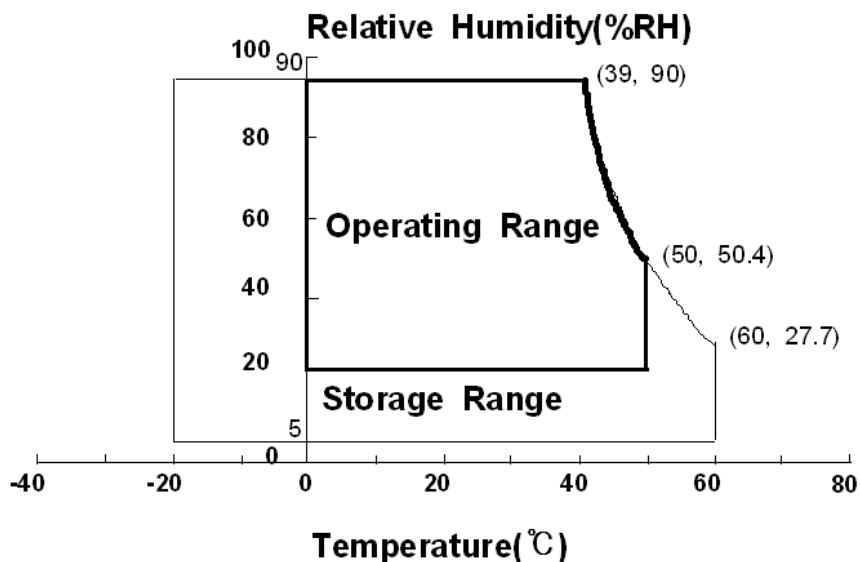
(2) Temperature and relative humidity range are shown in the figure below.

- a. 90 % RH Max. ( $T_a \leq 39$  °C)
- b. Relative Humidity is 90% or less. ( $T_a > 39$  °C)
- c. No condensation

(3) Although abnormal visual problems can be occurred in  $T_{SUR}$  range, the polarizer is not damaged in this 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**

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## 2. Optical Characteristics

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

Measuring equipment : TOPCON RD-80S, TOPCON SR-3, ELDIM EZ-Contrast

(Ta = 25 ± 2°C, VDD=12V, fv= 60Hz, fDCLK = 148.5MHz, LED Current Duty = 2D, 100%)

Item	Symbol	Condition	Min.	Typ.	Max.	Unit	Note
Contrast Ratio (Center of screen)	C/R		3000	4000	-		(1) SR-3
Response Time	G-to-G	Tg	-	6	-	msec	(3) RD-80S
Luminance of White (Center of screen)	Y <sub>L</sub>		-	2D : 450 3D : 160	-	cd/m <sup>2</sup>	(4) SR-3
Color Chromaticity (CIE 1931)	Red	Rx	Normal q <sub>L,R</sub> = 0 q <sub>U,D</sub> = 0  Viewing Angle	0.627	TYP. -0.03	TYP. +0.03	(5),(6) SR-3
		Ry		0.334			
	Green	Gx		0.322			
		Gy		0.624			
	Blue	Bx		0.157			
		By		0.048			
	White	Wx		0.280			
		Wy		0.290			
Color Gamut	-		-	72	-	%	(5) SR-3
Color Temperature	-		-	10,000	-	K	
Viewing Angle	Hor.	q <sub>L</sub>	C/R ≥ 10	75	89	-	Degree
		q <sub>R</sub>		75	89	-	
	Ver.	q <sub>U</sub>		75	89	-	
		q <sub>D</sub>		75	89	-	
White Brightness Uniformity (9 Points)	B <sub>uni</sub>		-	-	25	%	(2) SR-3

### - 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.

Environment condition : Ta = 25 ± 2 °C

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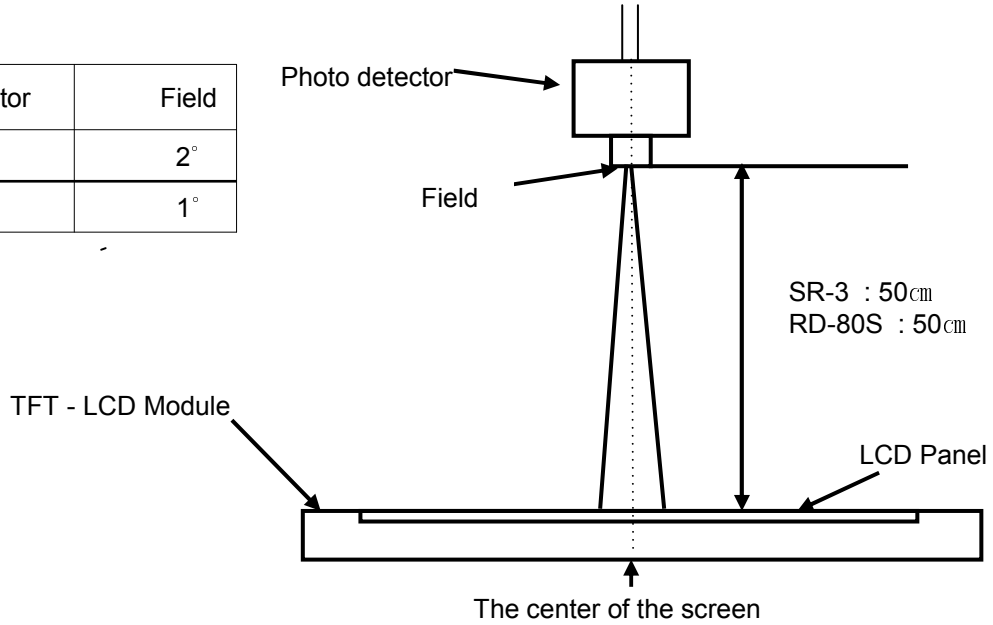
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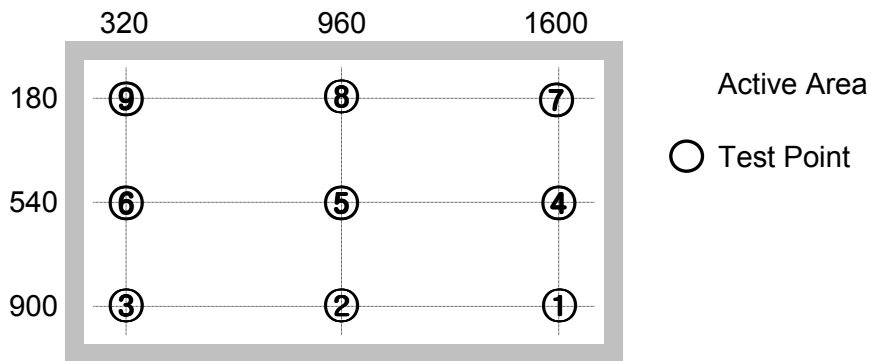
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Photo detector	Field
SR-3	2°
RD-80S	1°



- Definition of test point



Note (1) 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

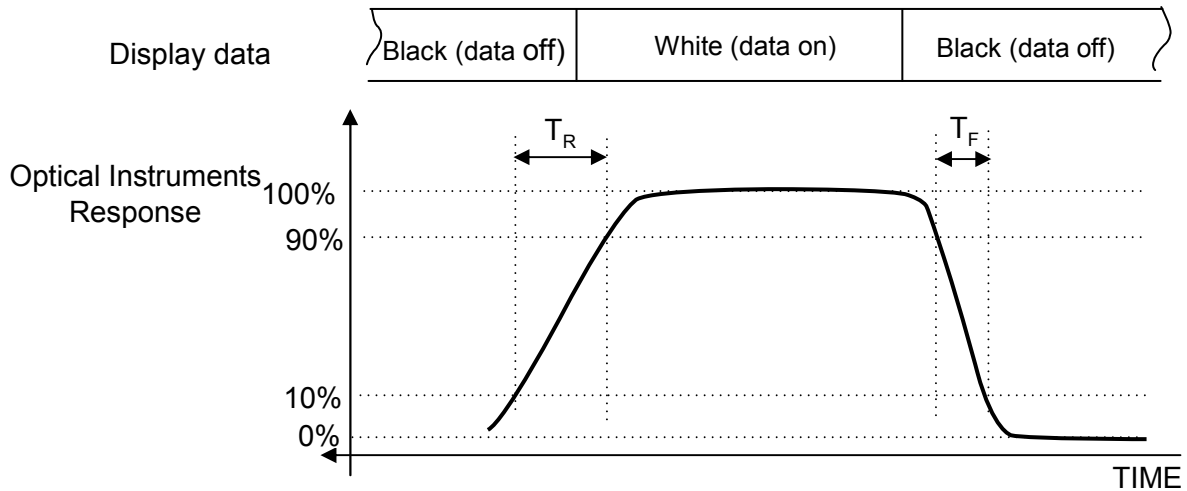
Gmin : Luminance with all pixels black

Note (2) Definition of 9 points brightness uniformity (Test pattern : Full White )

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

Bmax : Maximum brightness  
 Bmin : Minimum brightness

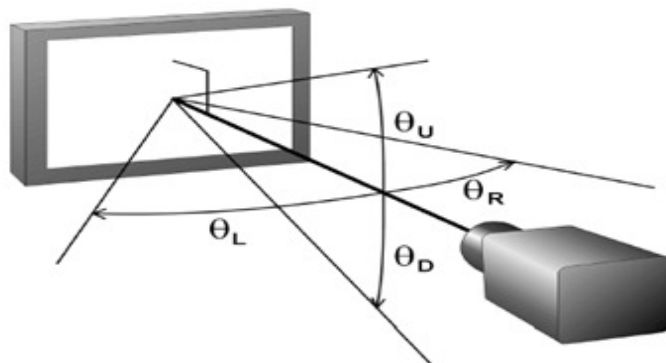
Note (3) Definition of Response time : Sum of Tr, Tf



Note (4) Definition of Luminance of White : Luminance of white at center point ⑤

Note (5) Definition of Color Chromaticity (CIE 1931)  
 Color coordinate of Red, Green, Blue & White at center point ⑤

Note (6) Definition of Viewing Angle  
 : Viewing angle range (C/R ≥ 10)



### 3. Electrical Characteristics

#### 3.1 TFT LCD Module

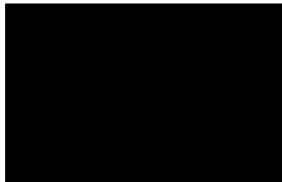
The connector for display data & timing signal should be connected.

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

Item	Symbol	Min.	Typ.	Max.	Unit	Note
Voltage of Power Supply	$V_{DD}$	10.8	12.0	13.2	V	(1)
Current of Power Supply	(a) Black	-	2360	-	mA	(2),(3)
	(b) White	-	2340	-	mA	
	(d) H-stripe	-	2390	2640	mA	
Rush Current	$I_{RUSH}$	-	-	7	A	(4)
		Video	PAL	NTSC	Unit	Note
Vsync Frequency	$f_V$	48 +/-0.5	50 +/-0.5	60 +/-0.5	Hz	
Hsync Frequency	$f_H$	64.8	67.5	67.5	kHz	
Main Frequency	Fdclk	142.56	148.5	148.5	MHz	

- 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)

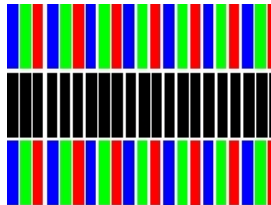
a) Black Pattern



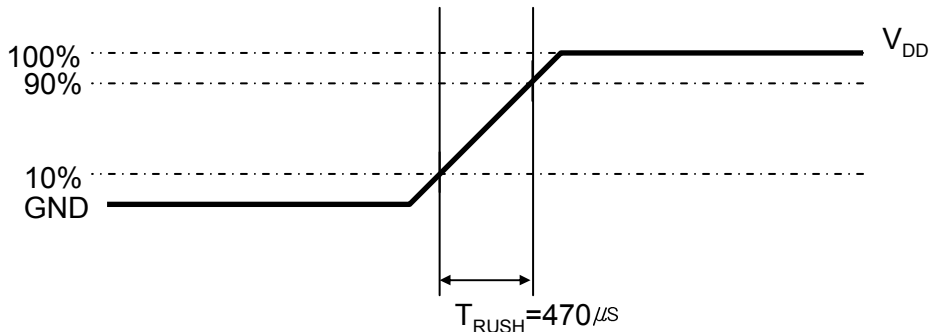
b) White Pattern



c) H-Stripe



#### (4) Measurement Conditions



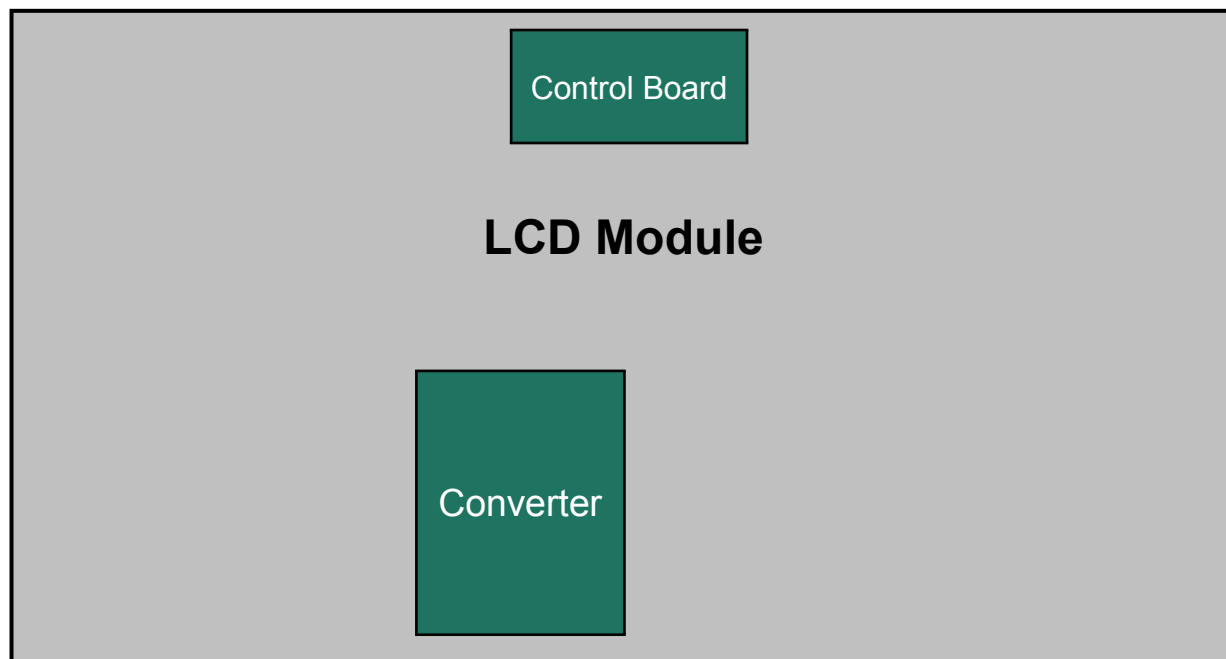
Rush Current  $I_{RUSH}$  can be measured when  $T_{RUSH}$  is  $470 \mu\text{s}$ .



### 3.2 Back Light Unit

The back light unit contains Edge type White LEDs (Light Emitting Diode)

Ta=25 ± 2°C



Item	Symbol	Min.	Typ.	Max.	Unit	Note
Operating Life Time	Hr	-	30,000	-	Hour	(1)

Note (1) It is defined as the time to take until the brightness reduces to 50% of its original value.

[Operating condition : Ta = 25± 2°C , For single lamp only. ]

### 3.3 Inverter Input Condition & Specification

Items	Symbol	Conditions	Specifications			Unit	Note
			Min.	Typ.	Max.		
Input Voltage	V <sub>in</sub>	-	22	24	26	V	Ta=25± 2 °C (2)
Input Current	I <sub>RUSH</sub>	V <sub>in</sub> =24.0V V <sub>dim</sub> =3.3V	-	-	10.9	A	(1)
LED Current	I <sub>O,MAX</sub>	V <sub>dim</sub> =3.3 V	105	110	115	mArms	2D (2)
			115	120	125		3D (2)
Backlight On/Off	ON	V <sub>in</sub> =24.0 V	2.4	-	5.25	V	(3)
	OFF	V <sub>in</sub> =24.0 V	0	-	0.8		
Dimming Control	V <sub>DIM</sub>	Max Lum	3.3	-	-	V	(3)
		Min. Lum	-	-	0		
PWM Frequency	F <sub>PWM</sub>	V <sub>in</sub> =24.0 V	140	150	160	Hz	
PWM Duty	Duty	V <sub>in</sub> =24.0 V	0	-	100	%	(4)

Note) Power Consumption is measured when 450 [cd/m ] of luminance which is the typical luminance.

Lamp Current is measured at the point before Lamp.

(1) Max Value of the Power Consumption is measured during initial turn on time\* of the backlight

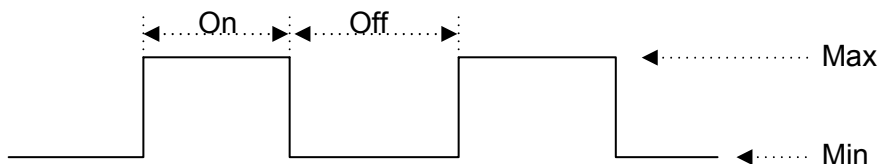
(2) Max Value of the Power Consumption is measured after 60 min warm-up.

(3) The ripple voltage should be controlled under 10% of Input Signal

(4) Recommended Duty range : 1% ~ 99%

$$\text{Duty} = \text{On}/(\text{On}+\text{Off}) * 100$$

\* Initial turn-on time : From 0sec to 60min after turn-on



## 4. Input Terminal Pin Assignment

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### 4.1. Input Signal & Power

Connector : FI-RE51S-HF (JAE)

Pin	Symbol	Description	Pin	Symbol	Description
1	12V	DC power supply	26	RE[0]P	Even LVDS Signal +
2	12V	DC power supply	27	RE[1]N	Even LVDS Signal -
3	12V	DC power supply	28	RE[1]P	Even LVDS Signal +
4	12V	DC power supply	29	RE[2]N	Even LVDS Signal -
5	12V	DC power supply	30	RE[2]P	Even LVDS Signal +
6	<b>NC</b>	<b>NOTE1</b>	31	GND	Ground
7	GND	Ground	32	ROCLK-	Even LVDS Clock -
8	GND	Ground	33	ROCLK+	Even LVDS Clock +
9	GND	Ground	34	GND	Ground
10	RO[0]N	Odd LVDS Signal -	35	RE[3]N	Even LVDS Signal -
11	RO[0]P	Odd LVDS Signal +	36	RE[3]P	Even LVDS Signal +
12	RO[1]N	Odd LVDS Signal -	37	RE[4]N	Even LVDS Signal -
13	RO[1]P	Odd LVDS Signal +	38	RE[4]P	Even LVDS Signal +
14	RO[2]N	Odd LVDS Signal -	39	GND	Ground
15	RO[2]P	Odd LVDS Signal +	40	<b>NC</b>	<b>NOTE1</b>
16	GND	Ground	41	<b>NC</b>	<b>NOTE1</b>
17	ROCLK-	Odd LVDS Clock -	42	<b>3D Enable</b>	<b>Low : 2D High : 3D</b>
18	ROCLK+	Odd LVDS Clock +	43	<b>NC</b>	<b>NOTE1</b>
19	GND	Ground	44	<b>NC</b>	<b>NOTE1</b>
20	RO[3]N	Odd LVDS Signal -	45	<b>NC</b>	<b>NOTE1</b>
21	RO[3]P	Odd LVDS Signal +	46	<b>I2C_SCL_F</b>	<b>Set use pin</b>
22	RO[4]N	Odd LVDS Signal -	47	<b>NC</b>	<b>NOTE1</b>
23	RO[4]P	Odd LVDS Signal +	48	<b>I2C_SDA_F</b>	<b>Set use pin</b>
24	GND	Ground	49	<b>3D Sync</b>	<b>Shutter glass sync signal</b>
25	RE[0]N	Even LVDS Signal -	50	<b>Main check</b>	<b>GND (NOTE2)</b>
			51	<b>NC</b>	<b>NOTE1</b>

**Note (1) No Connection: These PINS are used only for SAMSUNG. (DO NOT CONNECT)**

**Note (2) Main check : GND Only (Customer can control FRC Chip)**

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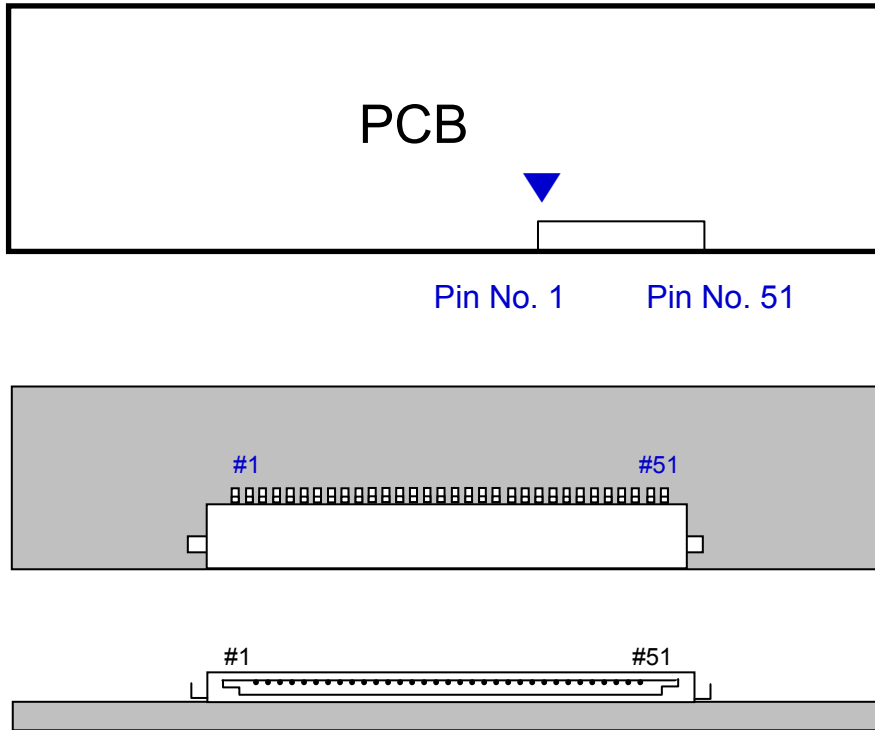
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Note) Pin number starts from Right side

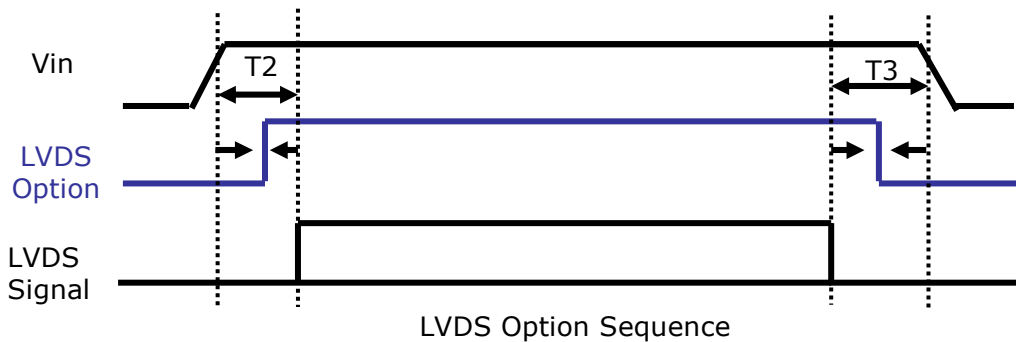


**Fig. Connector diagram**

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

Note(1) LVDS OPTION : If this PIN HIGH ( 3.3V ) → Normal LVDS format  
 LOW ( GND ) → JEIDA LVDS format

SEQUENCE : On = VDD(T1) → LVDS Option → Interface Signal(T2)  
 OFF = Interface Signal(T3) → LVDS Option → VDD



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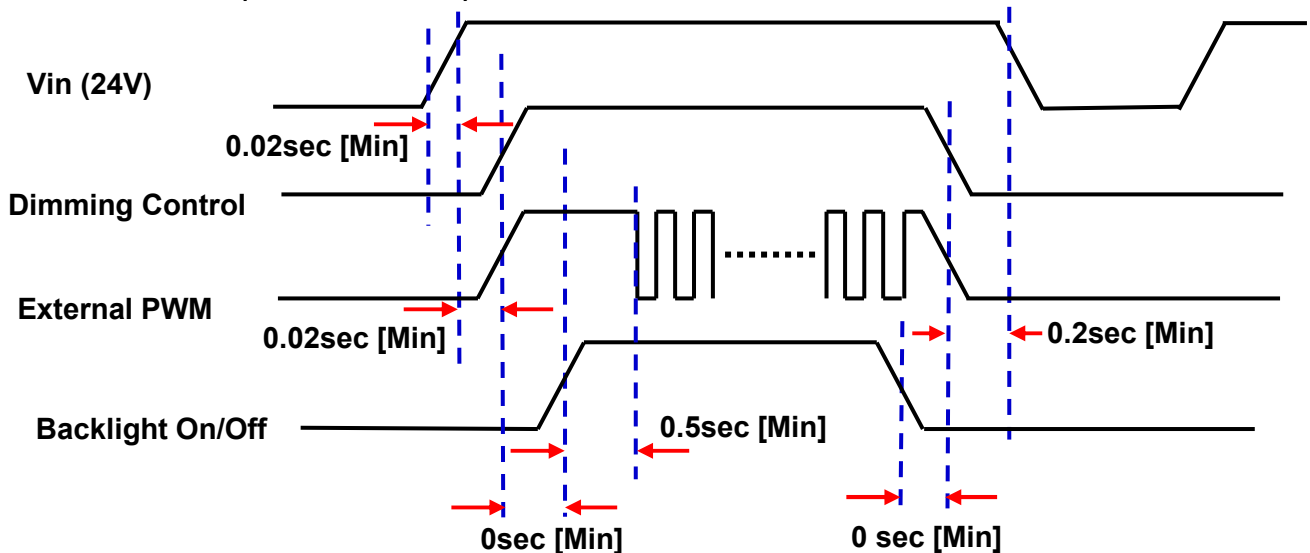
### 4.2. Inverter Input Pin Configuration

Connector : Yeon-ho, 20022WR-14B1

Pin No.	Pin Configuration (FUNCTION)
	Master
1	24 V
2	24 V
3	24 V
4	24 V
5	24 V
6	GND
7	GND
8	GND
9	GND
10	GND
11	Error Out
12	Backlight On /Off [ON:2.4 – 5.25 V, OFF: 0 - 0.8 V]
13	Dimming Control [0V:Min, 3.3V:Max]
14	No Connection * Note (1)

Note(1) No connection : This Pins are only used for SAMSUNG internal using

### 4.3. Inverter Input Power Sequence



Note) SEQUENCE : On = Vin(24V) > Internal or External PWN ≥ Backlight On/off  
 OFF = Backlight On/Off ≥ Internal or External PWN > Vin(24V)

#### 4.4 LVDS Interface

- LVDS Receiver : Tcon (merged)
- Data Format (JEIDA)

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	LVDS pin	JEIDA -DATA
TxOUT/RxIN0	TxIN/RxOUT0	R4
	TxIN/RxOUT1	R5
	TxIN/RxOUT2	R6
	TxIN/RxOUT3	R7
	TxIN/RxOUT4	R8
	TxIN/RxOUT6	R9
	TxIN/RxOUT7	G4
TxOUT/RxIN1	TxIN/RxOUT8	G5
	TxIN/RxOUT9	G6
	TxIN/RxOUT12	G7
	TxIN/RxOUT13	G8
	TxIN/RxOUT14	G9
	TxIN/RxOUT15	B4
	TxIN/RxOUT18	B5
TxOUT/RxIN2	TxIN/RxOUT19	B6
	TxIN/RxOUT20	B7
	TxIN/RxOUT21	B8
	TxIN/RxOUT22	B9
	TxIN/RxOUT24	HSYNC
	TxIN/RxOUT25	VSYNC
	TxIN/RxOUT26	DEN
TxOUT/RxIN3	TxIN/RxOUT27	R2
	TxIN/RxOUT5	R3
	TxIN/RxOUT10	G2
	TxIN/RxOUT11	G3
	TxIN/RxOUT16	B2
	TxIN/RxOUT17	B3
	TxIN/RxOUT23	RESERVED
TxOUT/RxIN4	TxIN/RxOUT28	R0
	TxIN/RxOUT29	R1
	TxIN/RxOUT30	G0
	TxIN/RxOUT31	G1
	TxIN/RxOUT32	B0
	TxIN/RxOUT33	B1
	TxIN/RxOUT34	RESERVED

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## 5. Interface Timing

### 5.1.1 Timing Parameters ( FRC mode Video )

SIGNAL	ITEM	SYMBOL	Video	PAL	NTSC	UNIT	NOTE
Clock	Frequency	1/TC	101	142.56	152	MHz	-
Hsync		Fh	-	64.8	-	KHz	-
Vsync		Fv	47.5	48	48.5	Hz	-
Vertical Active Display Term	Display Period	TVD	-	1080	-	Lines	-
	Vertical Total	TV	1094	1350	1639	Lines	-
Horizontal Active Display Term	Display Period	THD	-	1920	-	Clocks	-
	Horizontal Total	TH	1952	2200	2924	clocks	-

### 5.1.2 Timing Parameters ( FRC Input Mode PAL )

SIGNAL	ITEM	SYMBOL	Video	PAL	NTSC	UNIT	NOTE
Clock	Frequency	1/TC	106	148.5	152	MHz	-
Hsync		Fh	-	67.5	-	KHz	-
Vsync		Fv	49.5	50	50.5	Hz	-
Vertical Active Display Term	Display Period	TVD	-	1080	-	lines	-
	Vertical Total	TV	1094	1350	1573	lines	-
Horizontal Active Display Term	Display Period	THD	-	1920	-	clocks	-
	Horizontal Total	TH	1952	2200	2806	clocks	-



### 5.1.3 Timing Parameters ( FRC Input NTSC )

SIGNAL	ITEM	SYMBOL	Video	PAL	NTSC	UNIT	NOTE
Clock	Frequency	1/TC	127	148.5	152	MHz	-
Hsync		Fh	-	67.5	-	KHz	-
Vsync		Fv	59.5	60	60.5	Hz	-
Vertical Active Disply Term	Display Period	TVD	-	1080	-	Lines	-
	Vertical Total	TV	1094	1125	1308	Lines	-
Horizontal Active Display Term	Display Period	THD	-	1920	-	Clocks	-
	Horizontal Total	TH	1952	2200	2334	clocks	-

Note) This product is DE mode.

The input of Negative Hsync & Vsync signal is essentially needed.

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

(2) Internal V<sub>DD</sub> = 3.3V

(3) Spread spectrum

- Modulation rate (max) : ± 2.8 %

- Modulation Frequency : under 62.5KHz

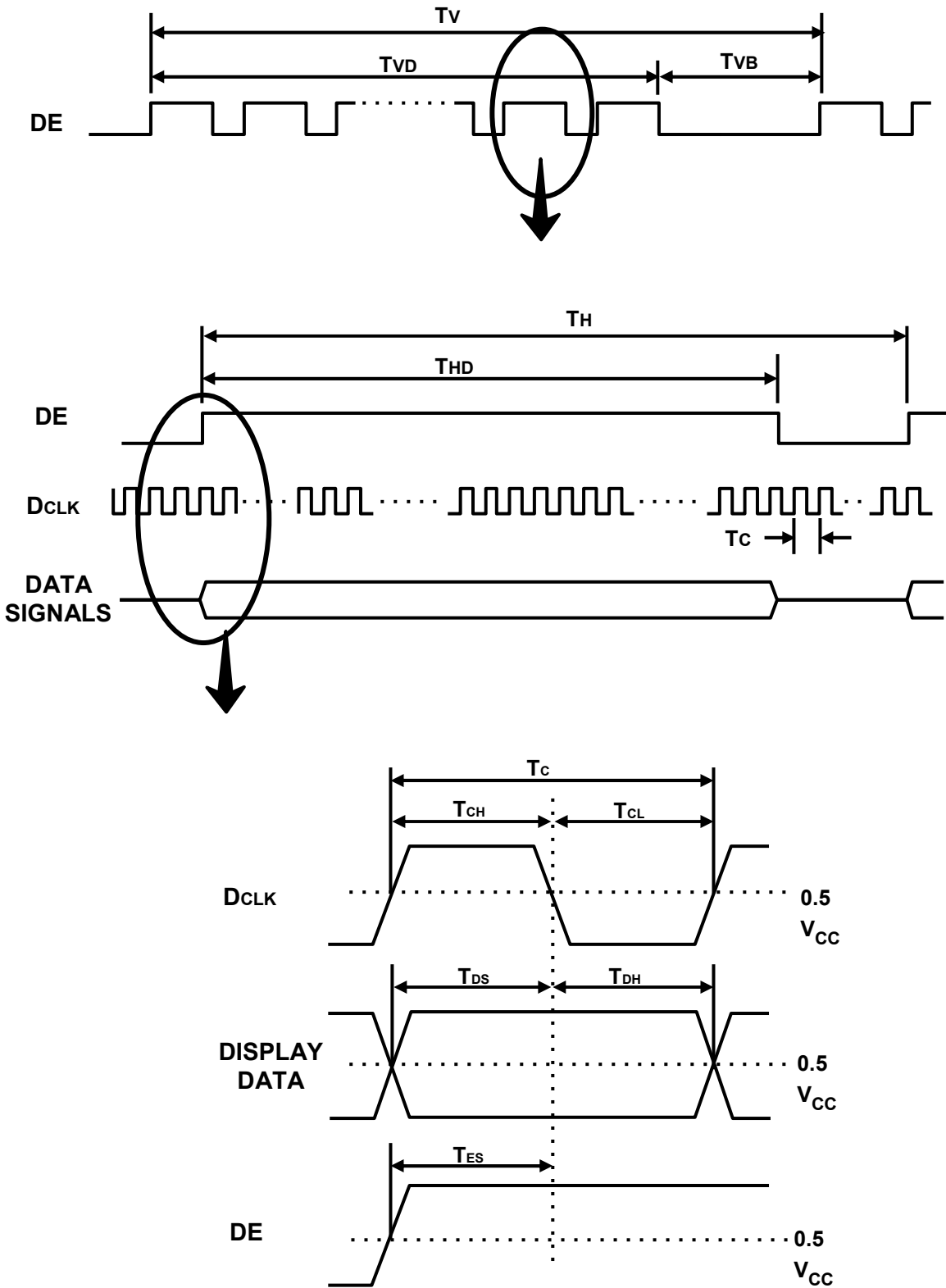
### 5.2 LVDS Input Data Position (FRC Input)

ITEM		SYMBOL	Min.	Typ.	Max.	UNIT	NOTE
Input Data Position	F <sub>IN</sub> =90MHz	t <sub>RSRM</sub>	-	-	220	ps	-
	F <sub>IN</sub> =74.25MHz		-	-	340	ps	
Input Data Position	F <sub>IN</sub> =90MHz	t <sub>RSLM</sub>	220	-	-	ps	
	F <sub>IN</sub> =74.25MHz		340	-	-	ps	
Input common mode voltage		V <sub>CM</sub>	0.3	-	1.8	V	-
Differential Input Voltage		V <sub>ID</sub>	100	200	500	mV	-

Note) When the skew is measured the Spread Spectrum should be 0%

5.3 Timing diagrams of interface signal ( DE mode )

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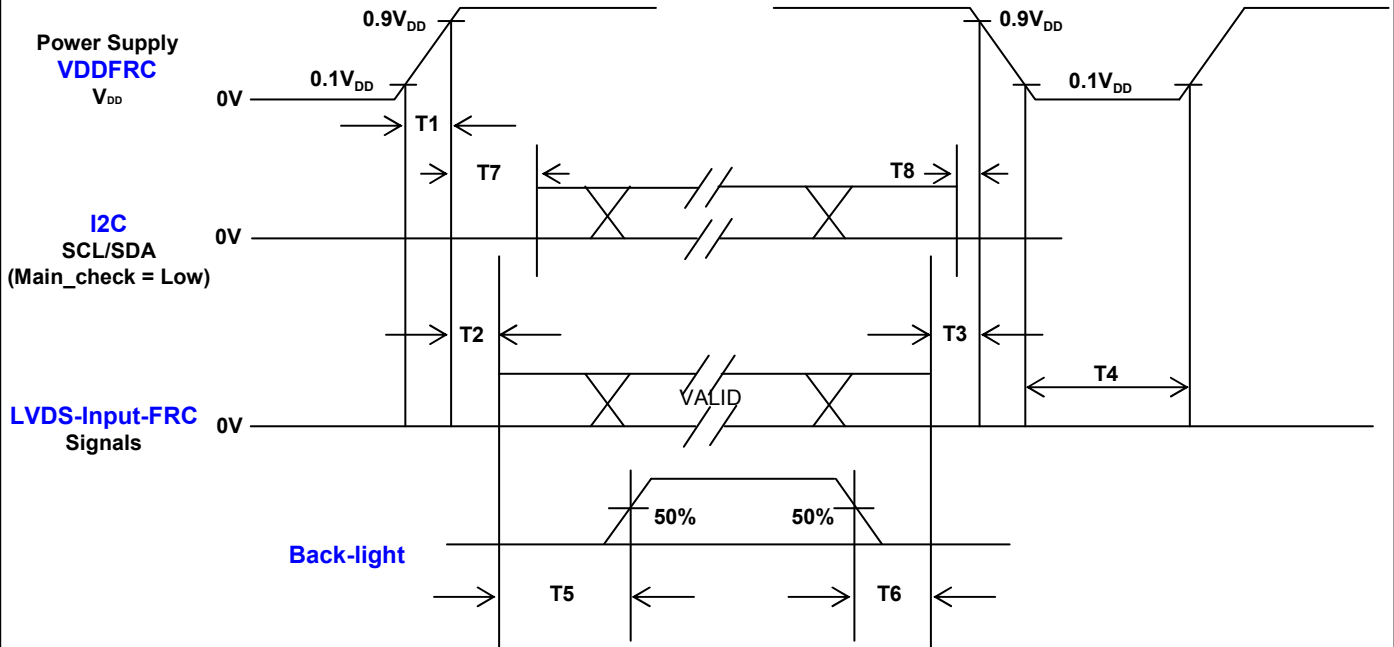


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## 5.4 Power ON/OFF Sequence

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



$$0.5\text{msec} < T1 \leq 10\text{msec}$$

$$0 < T2 \leq 50\text{msec}$$

$$0 < T3 \leq 50\text{msec}$$

$$1000\text{msec} \leq T4$$

$$6500\text{msec} \leq T5$$

$$\text{(Recommend Value)} 100\text{msec} \leq T6$$

$$3700\text{msec} < T7$$

$$\text{(Recommend Value)} 0\text{msec} \leq T8$$

T1 : V<sub>DD</sub> rising time from 10% to 90%

T2 : The time from V<sub>DD</sub> to valid data at power ON.

T3 : The time from valid data off to V<sub>DD</sub> off at power Off.

T4 : V<sub>DD</sub> off time for Windows restart

T5 : The time from valid data to B/L enable at power ON.

T6 : The time from valid data off to B/L disable at power Off.

T7 : The time from V<sub>DD</sub> to valid I2C signal at power ON.

T8 : The time from valid I2C signal off to V<sub>DD</sub> off at power Off.

- The supply voltage of the external system for the Module input should be the same as the definition of V<sub>DD</sub>.
- 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<sub>DD</sub> = 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.
- In Case T5 is less than 1000msec and T6 is less than 100msec, Garbage Display can be seen. (It is not related to electrical function issue, Just for recommendation to prevent Garbage Display )

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## 6. Outline Dimension- Front

**Samsung Secret**

**TBD**

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## 6. Outline Dimension- Rear

**Samsung Secret**

**TBD**

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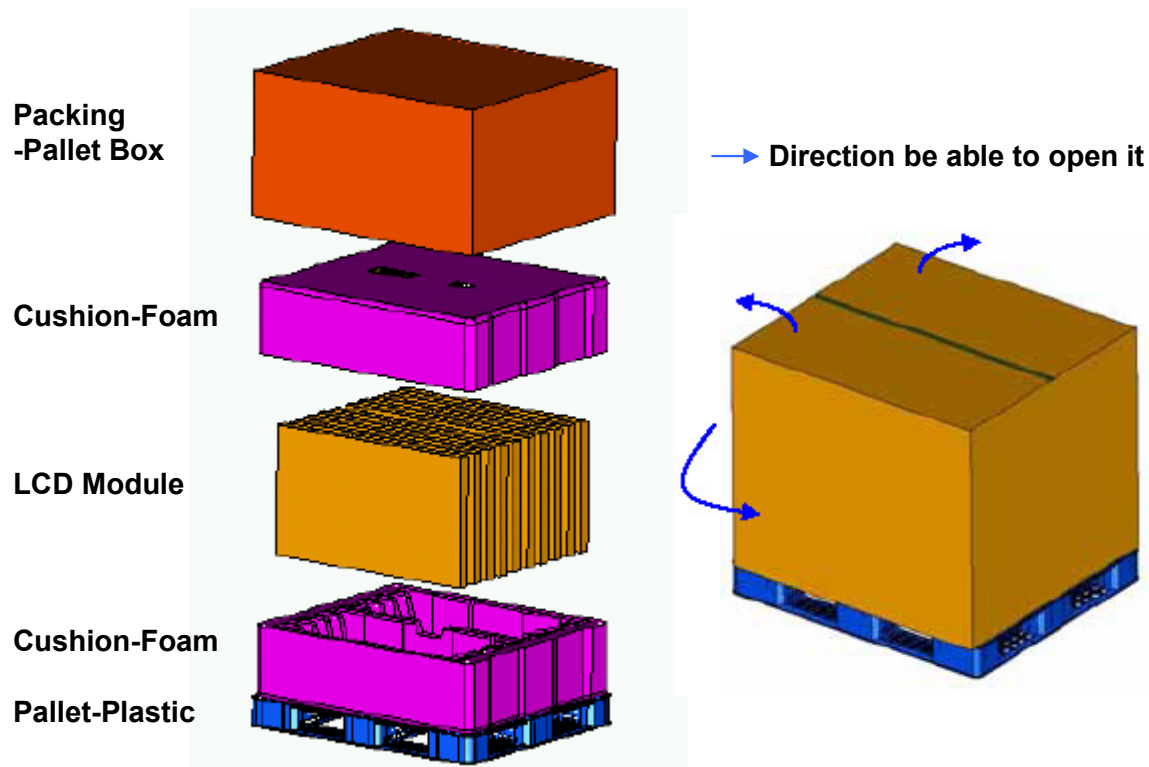
## 7. PACKING

### 7.1 CARTON (Internal Package)

(1) Packing Form

Corrugated fiberboard box and corrugated cardboard as shock absorber

(2) Packing Method



### 7.2 Packing Specification

Item	Specification	Remark
LCD Packing	13ea / (Packing-Pallet Box)	1. 182 kg / LCD (13ea) 2. 15.3 Kg / Cushion-pallet (2ea) 3. 10.5 Kg / Packing-Pallet Box (1ea) 4. Cushion-pallet Material : EPS 5. Packing-Pallet Box Material : SW4
Pallet	1Box / Pallet	1. Pallet weight = 10kg
Packing Direction	Vertical	
Total Pallet Size	H x V x height	1475mm(H) x 1150mm(V) x 995mm(height)
Total Pallet Weight	217.8 kg	Pallet(10kg) + Module (182 kg) + Cushion (up + bottom =15.3kg) + Pallet-BOX(10.5kg)

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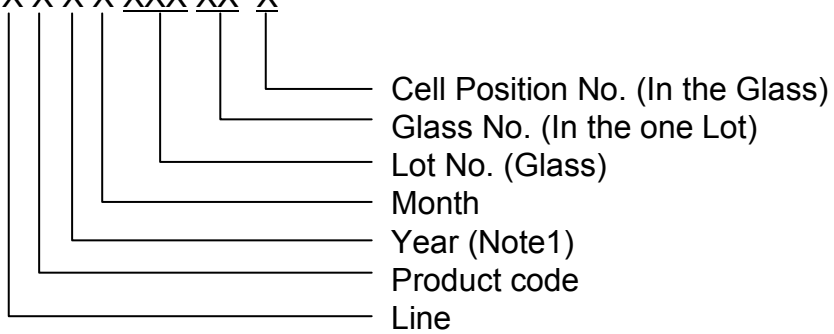
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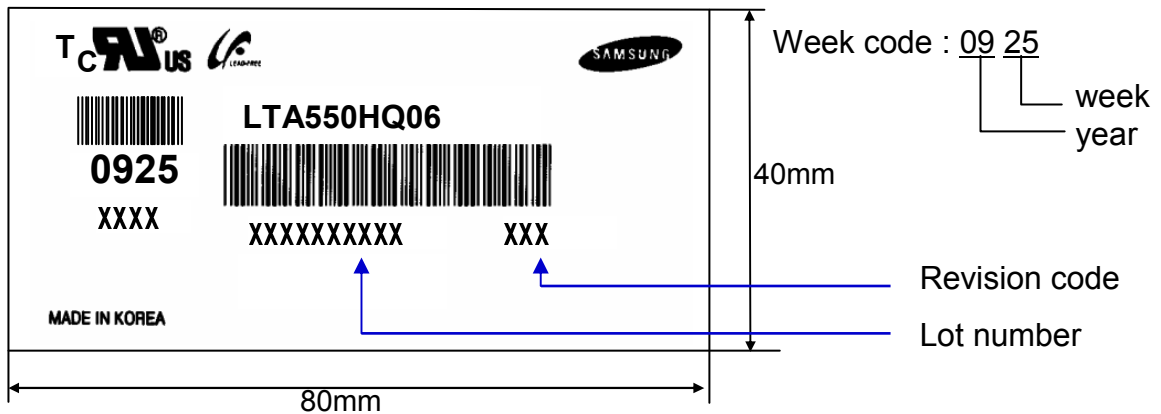
## 8. MARKING & OTHERS

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

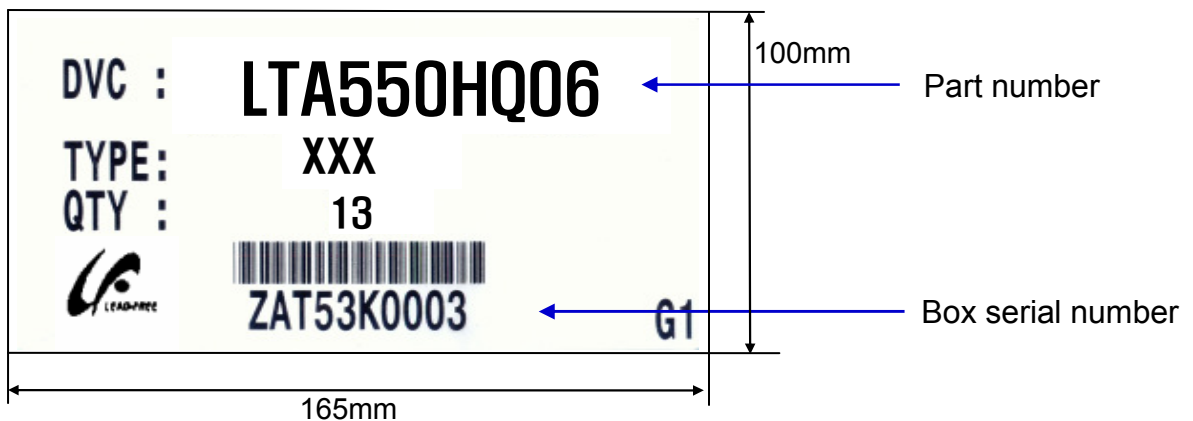
- (1) Part number : LTA550HQ06
- (2) Revision: Three letters
- (3) Lot number : X X X X XXX XX X



### (4) Nameplate Indication



### (5) Packing box attach



### (6) Others

- 1. After service part

Lamps cannot be replaced because of the narrow bezel structure.

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## 9. General Precautions

### 9.1 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 CCFT 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 Electrostatic discharge. Otherwise the ASIC IC or semiconductor 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 disassemble shield case of inverter & LVDS board
- (m) Do not connect N.C pins. (Samsung internal use only)
- (n) Protection film for polarizer on the Module should be slowly peeled off just before use so that the electrostatic charge can be minimized. Must put on antistatic glove while handling a module
- (o) Pins of I/F connector should not be touched directly with bare hands.

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## 9.2 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 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 should be stored in a dark place. It is prohibited to apply sunlight or fluorescent light in storing.

## 9.3 Operation

- (a) Do not connect or disconnect the Module in the "Power On" condition.
- (b) Power supply should always be turned on/off by the "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 inverter 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).

## 9.4 Operation Condition Guide

- (a) The LCD product should be operated under normal conditions.  
Normal condition is defined as below;
  - Temperature :  $20 \pm 15$  °C
  - Humidity :  $55 \pm 20$  %
  - Display pattern : continually changing pattern (Not stationary)
- (b) If the product will be used in extreme conditions such as high temperature, humidity, display patterns or operation time etc., It is strongly recommended to contact SEC for Application engineering advice. Otherwise, its reliability and function may not be guaranteed. Extreme conditions are commonly found at Airports, Transit Stations, Banks, Stock market, and Controlling systems.

## 9.5 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.

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