PI

Customer :   DATE :19. Jan. 2011

SAMSUNG TFT-LCD

MODEL : **LSJ320HN01**

Any Modification of Specification is not allowed without SEC's Permission.

NOTE :

Customer's Approval		APPROVAED BY Heo Jeongmin	DATE 19. Jan. 2011
SIGNATURE	DATE	PREPARED BY Bong U Lee	DATE 19. Jan. 2011

LCD Business

Samsung Electronics Co . , LTD.

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Revision History

Date	Rev. No	Page	Summary
19. Nov. 2010	000	all	First issued
19. Jan 2011	001	25 page	Storage

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General Description

Description

LSJ320HN01 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 source PBAs. The resolution of a 32" is 1920 x 1080 and this model can display up to 16.7 Million colors with wide viewing angle of 89° or higher in all directions. This panel is intended to support applications to provide a excellent performance for Flat Panel Display such as Home-alone Multimedia TFT-LCD TV and High Definition TV.

Features

- High contrast & aperture ratio with wide color gamut
- SVA (Super Vertical Align) mode
- Wide viewing angle (±178°)
- High speed response
- FHD resolution (16:9)
- LVDS (Low Voltage Differential Signaling) interface (2pixel/clock)

General Information

Items	Specification	Unit	Note
Panel Size	715.4 (H_{TYP}) x 411.8(V_{TYP})	mm	±0.2mm
	1.76(D_{MAX})		±0.15mm
Weight	1.1(Max.)	kg	±0.1Kg
Pixel Pitch	0.12125 (H) × 0.36375 (V)	mm	
Active Display Area	698.4 (H) ×392.85 (V)	mm	
Surface Treatment	Haze 0%, Hard-Coating (2H)		
Display Colors	8 Bits-True, 16.7M	colors	
Number of Pixels	1920 x 1080	pixel	
Pixel Arrangement	RGB vertical stripe		
Display Mode	Normally Black		

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1. Absolute Maximum Ratings

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

$(Vss = 0 V)$

Item		Symbol	Min.	Max.	Unit	Note
Power Supply Voltage		V_{DD}	10.8	13.2	V	(1)
Storage temperature		T_{STG}	-20	65	℃	(2)
Glass surface temperature (Operation)	Center	T_{OPR}	0	50	℃	(2)

Note (1) Ta= 25 ± 2 °C

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

a. 90 % RH Max. (Ta ≤ 39 °C)

b. Relative Humidity is 90% or less. (Ta > 39 °C)

c. No condensation

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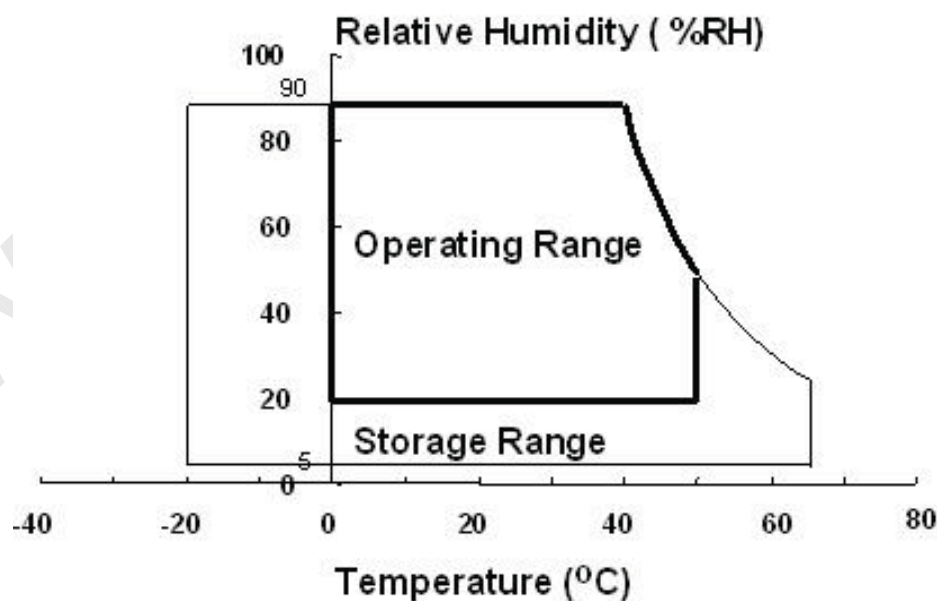
2. Optical Characteristics

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 $\pm$ 2°C, VDD=12.0V,   fv= 120Hz, f_{DCLK}=148.5MHz)

Item		Symbol	Condition	Min.	Typ.	Max.	Unit	Note
Contrast Ratio (Center of screen)		C/R		4000	5000	-		(1) SR-3
Response Time	G-to-G	Tg		-	8	16	msec	(3) RD-80S
Luminance of White (Center of screen)		Y_L		400	450	-	cd/m²	(4) SR-3
Color Chromaticity (CIE 1931)	Red	Rx	Normal θ**L,R**=0 θ**U,D**=0 Viewing Angle	TYP. -0.03	0.640	TYP. +0.03		(5),(6) SR-3
		Ry			0.330			
	Green	Gx			0.300			
		Gy			0.640			
	Blue	Bx			0.150			
		By			0.060			
	White	Wx			0.280			
		Wy			0.290			
Color Gamut		-			82	-	%	(5) SR-3
Color Temperature		-		-	10000	-	K	
Viewing Angle	Hor.	θ_L	C/R≥10	79	89	-	Degree	(6) EZ-Contrast
		θ_R		79	89	-		
	Ver.	θ_U		79	89	-		
		θ_D		79	89	-		
Brightness Uniformity (9 Points)		B_{uni}		-	-	25	%	(2) SR-3

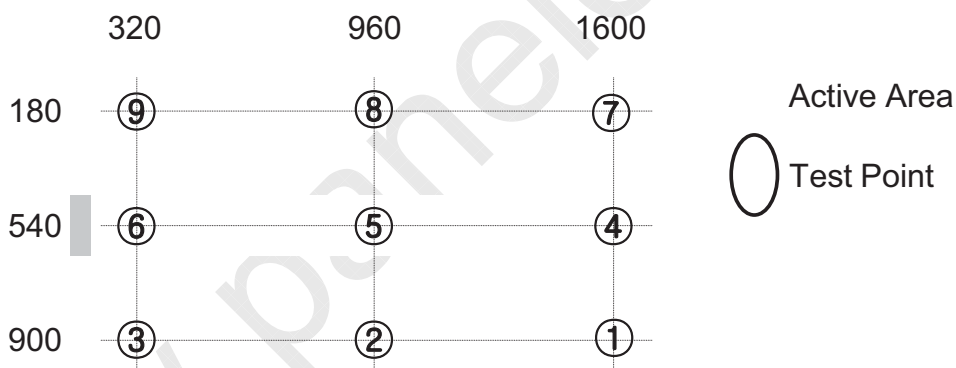- Test Equipment Setup

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 $\pm$ 2 °C

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Photo detector	Field
SR3	1°
RD-80S	2°

Photo detector

Field

BM-5A : 50㎝
RD-80S : 50㎝
EZ-Contrast:0㎝

TFT - LCD Module

LCD Panel

The center of the screen
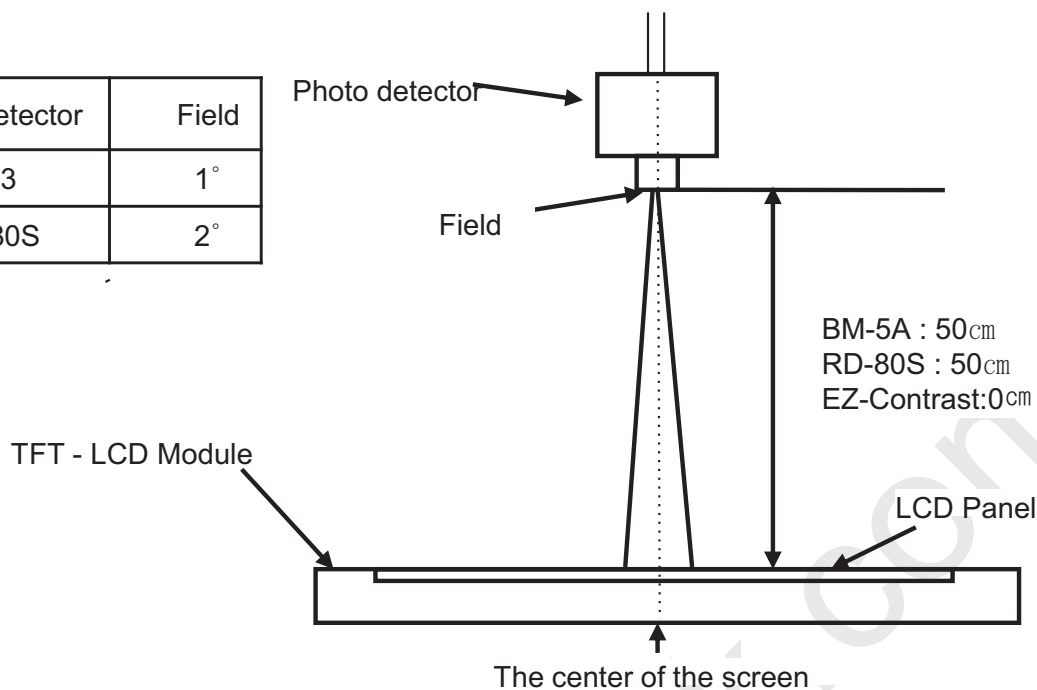
- Definition of test point

```
        320        960       1600
180      ⑨          ⑧          ⑦        Active Area

                                          ◯  Test Point
540      ⑥          ⑤          ④

900      ③          ②          ①
```

Note (1) Definition of Contrast Ratio (C/R)
   : Ratio of gray max (Gmax) & gray min (Gmin) at the center point ⑤ of the panel

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

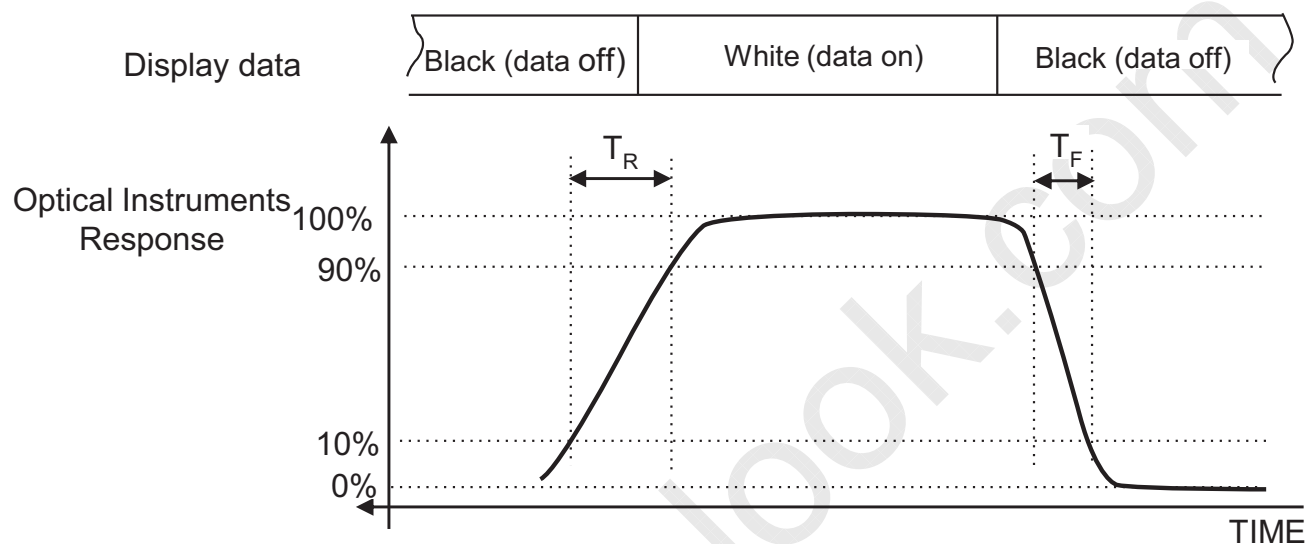Gmax : Luminance with all pixels white
Gmin : Luminance with all pixels black

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

$$Buni = 100 * \frac{(B\max - B\min)}{B\max}$$

Bmax : Maximum brightness
Bmin : Minimum brightness

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

※ G-to-G : Average response time between Gray to Gray (Scale)
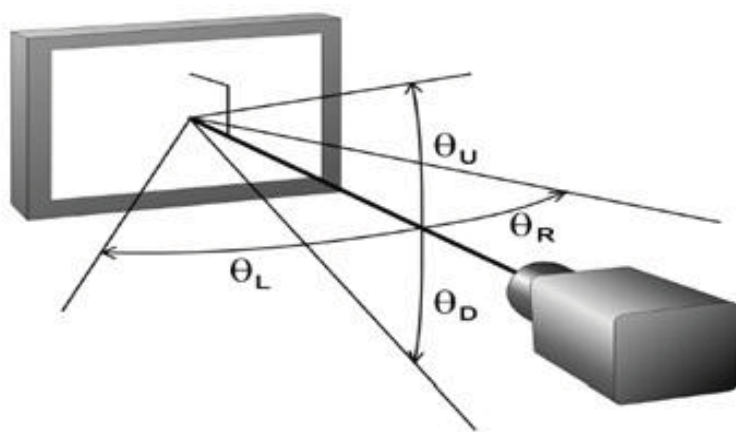
Note (4) Definition of Luminance of White : Luminance of white at center point ⑤

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)

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3. Electrical Characteristics

3.1 TFT LCD Module

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

Ta = 25°C $\pm$ 2 °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	I_{DD}	300	300	700	mA	(2),(3)
	(b) White		500	700	900	mA	
	(c) N-pattern		600	800	1000	mA	
Vsync Frequency		f_V	47	60	63	Hz	
Hsync Frequency		f_H	50	67.5	75	kHz	
Main Frequency		Fdclk	130	148.5	160	MHz	
Rush Current		I_{RUSH}			4	A	(4)

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

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

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

a) Black Pattern   b) White Pattern   c) N-pattern
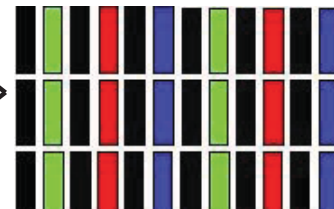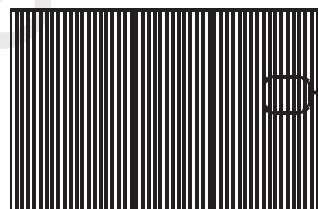
(4) Measurement Conditions

T_{RUSH}=470μs

Rush Current I_{RUSH} can be measured when T_{RUSH}. is 470μs.

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4. Block Diagram
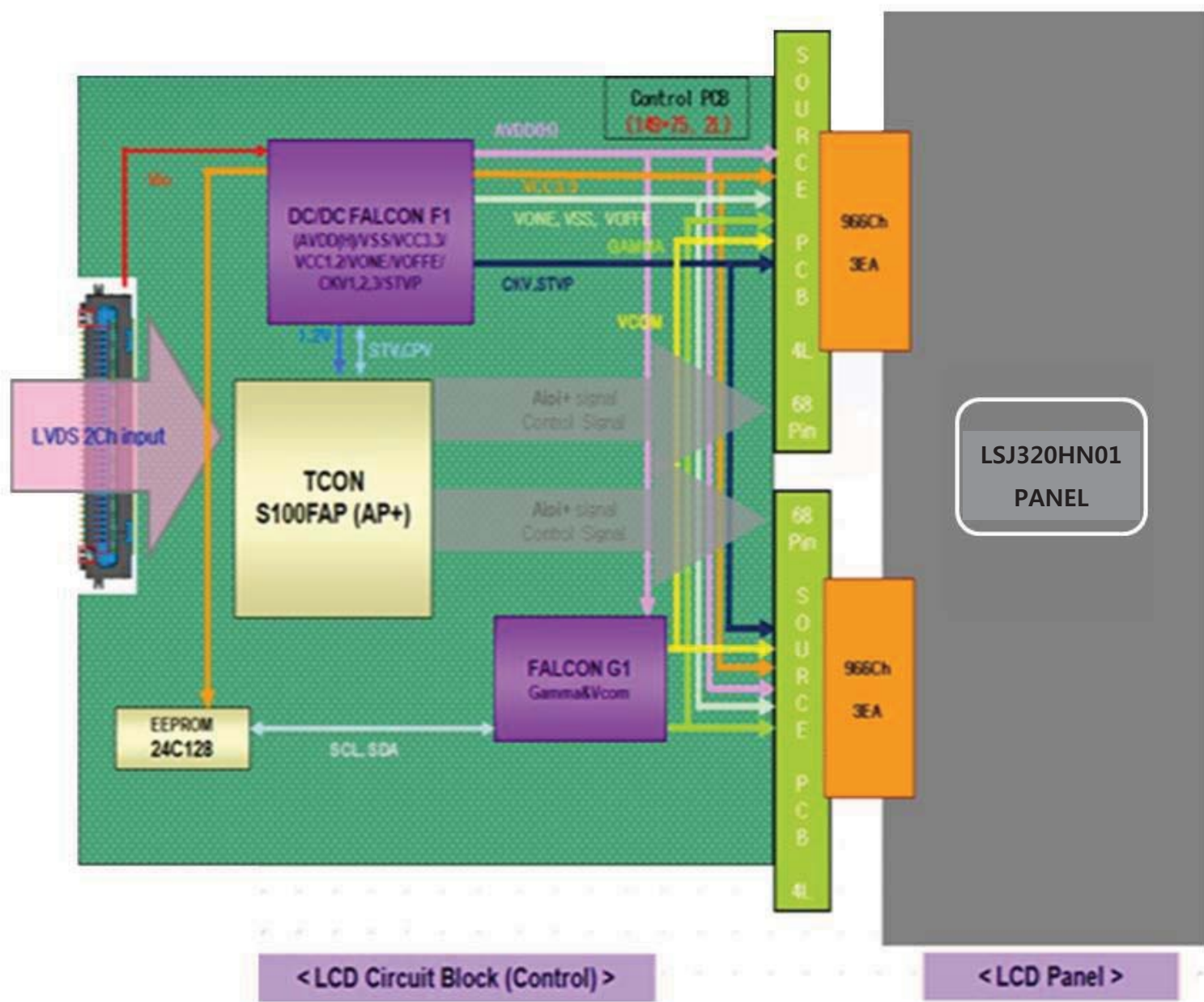
5. Input Terminal Pin Assignment

5.1. Input Signal & Power

Connector : FI-RE51S-HF (JAE)

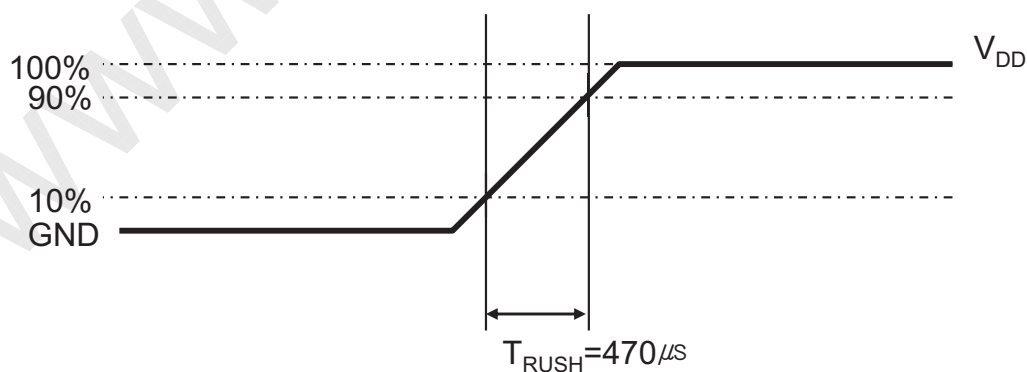| No		No	
1	DC power supply V_{DD}(+12[V])	26	Even LVDS Signal +
2	DC power supply V_{DD}(+12[V])	27	Even LVDS Signal -
3	DC power supply V_{DD}(+12[V])	28	Even LVDS Signal +
4	DC power supply V_{DD}(+12[V])	29	Even LVDS Signal -
5	DC power supply V_{DD}(+12[V])	30	Even LVDS Signal +
6	Not Connected *	31	GND
7	GND	32	Even LVDS Clock -
8	GND	33	Even LVDS Clock +
9	GND	34	GND
10	Odd LVDS Signal -	35	Even LVDS Signal -
11	Odd LVDS Signal +	36	Even LVDS Signal +
12	Odd LVDS Signal -	37	Not Connected *
13	Odd LVDS Signal +	38	Not Connected *
14	Odd LVDS Signal -	39	GND
15	Odd LVDS Signal +	40	SCL__I
16	GND	41	Not Connected*
17	Odd LVDS Clock -	42	Not Connected *
18	Odd LVDS Clock +	43	WP
19	GND	44	SDA__I
20	Odd LVDS Signal -	45	LVDS_SEL
21	Odd LVDS Signal +	46	Aging enable
22	Not Connected *	47	Not Connected
23	Not Connected *	48	Not Connected
24	GND	49	Not Connected
25	Even LVDS Signal -	50	Not Connected
		51	HVS

JEIDA/NORMAL:

ⓐ GND : JEIDA

ⓑ HIGH : NORMAL (VESA)

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Note) Pin number starts from Left side

PCB

Pin No. 1   Pin No. 51
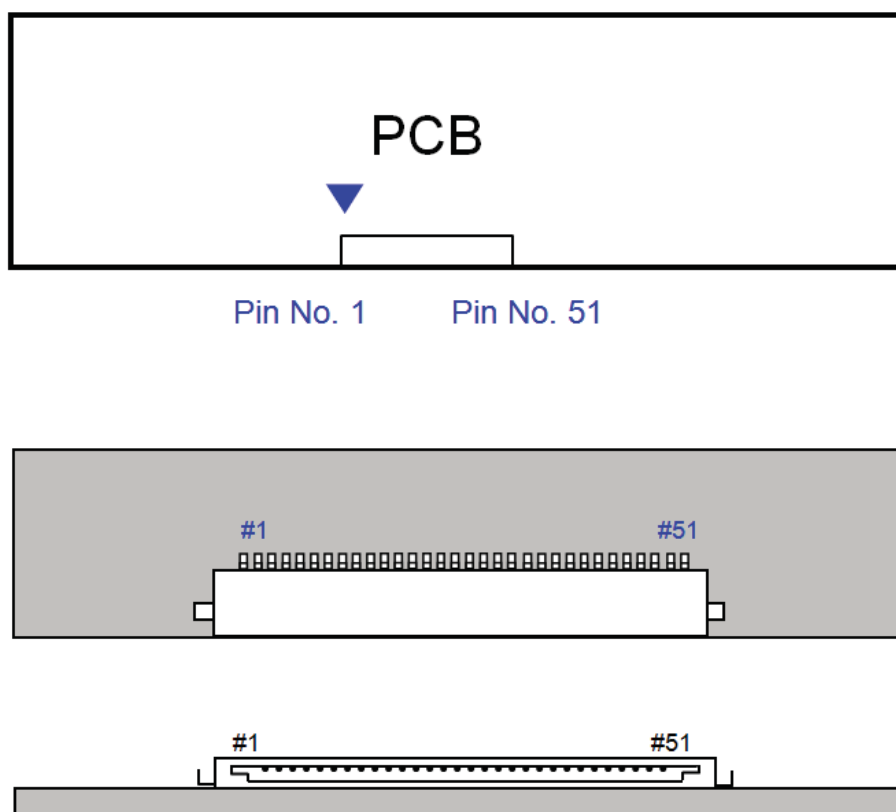
#1   #51

#1   #51

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.

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6. Input Terminal Pin Assignment
6.1 LVDS Interface
- LVDS Receiver : Tcon (merged)
- JEIDA & Normal Data Format

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

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

COLOR	DISPLAY	R0	R1	R2	R3	R4	R5	R6	R7	G0	G1	G2	G3	G4	G5	G6	G7	B0	B1	B2	B3	B4	B5	B6	B7	GRAY SCALE LEVEL
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
	↓	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
	LIGHT	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
	↓	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
	LIGHT	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
	↓	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
	LIGHT	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

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7. Interface Timing

7.1 Timing Parameters

SIGNAL	ITEM	SYMBOL	MIN.	TYP.	MAX.	Unit	NOTE
Clock	Frequency	$1/T_C$	130	148.5	160	MHz	-
Hsync		F_H	50	67.5	75	KHz	-
Vsync		F_V	47	60	63	Hz	-
Vertical Display Term	Active Display Period	T_{VD}	-	1080	-	Lines	-
	Vertical Total	T_V	1092	1125	1158	Lines	-
Horizontal Display Term	Active Display Period	T_{HD}	-	1920	-	Clocks	-
	Horizontal Total	T_H	2090	2200	2350	clocks	-

Note)

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

    (2) Internal V_{DD} = 3.3V

    (3) Spread spectrum

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7.2 Timing diagrams of interface signal
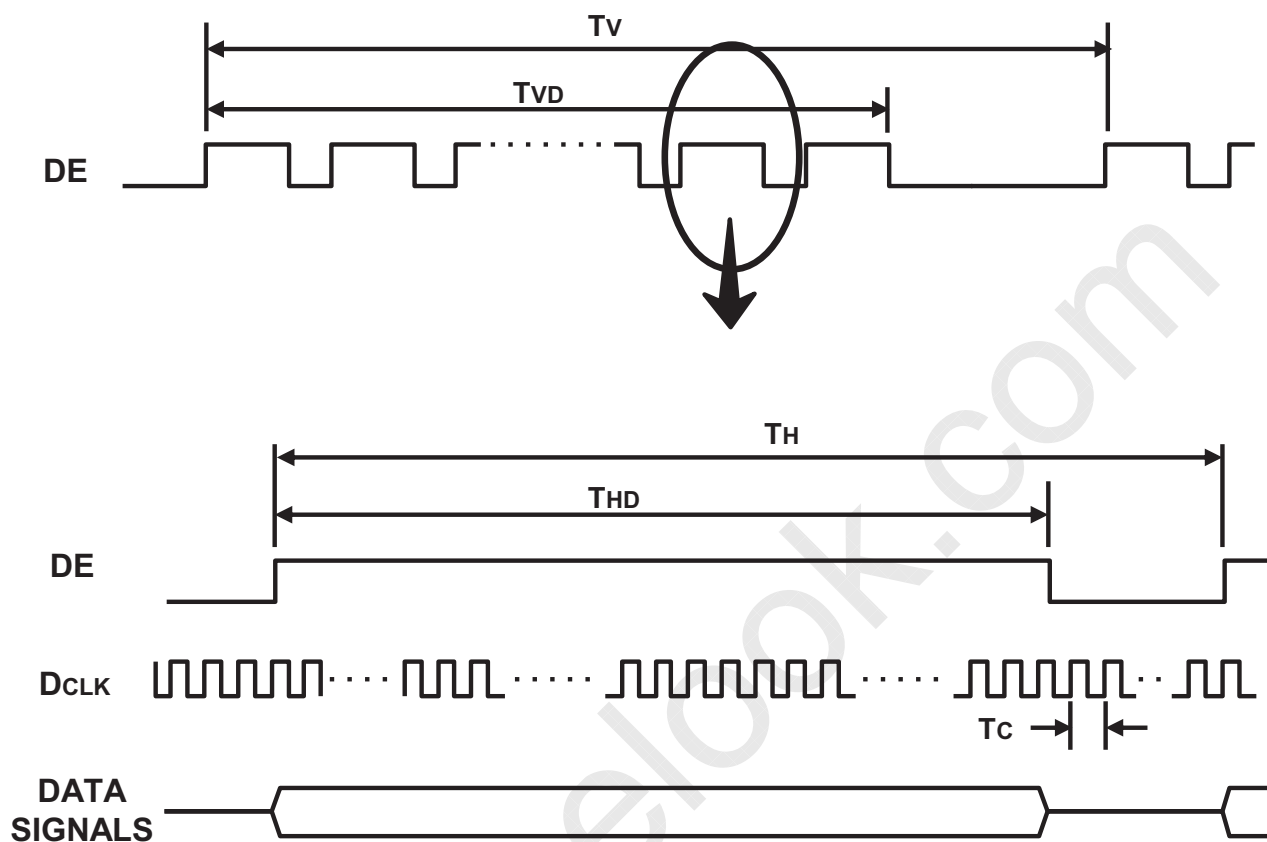
7.3 Power ON/OFF Sequence

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

0.5ms<T1≤10ms
1<T2≤50ms
0<T3≤50ms
1000ms≤T4

1000ms≤T5

100ms≤T6
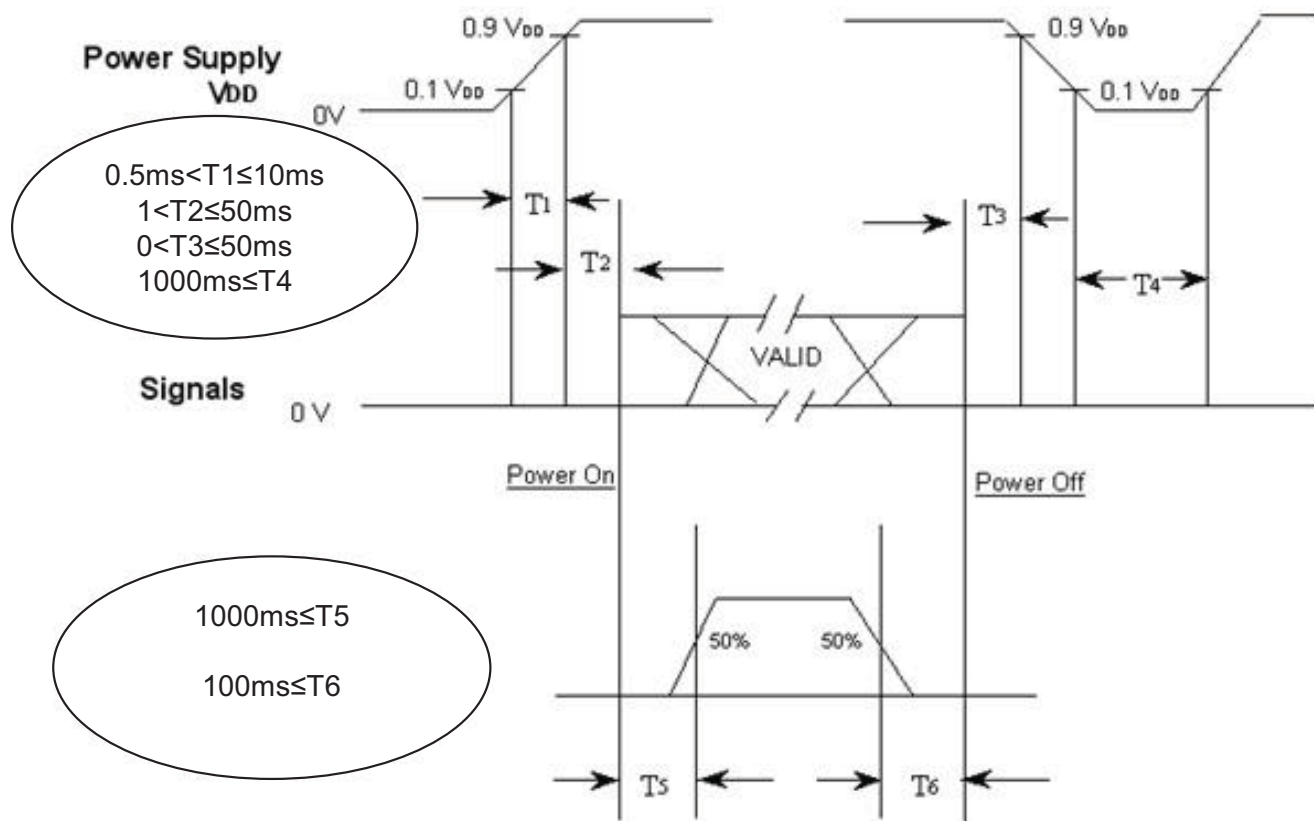
T1 : V_{DD} rising time from 10% to 90%
T2 : The time from V_{DD} to valid data at power ON.
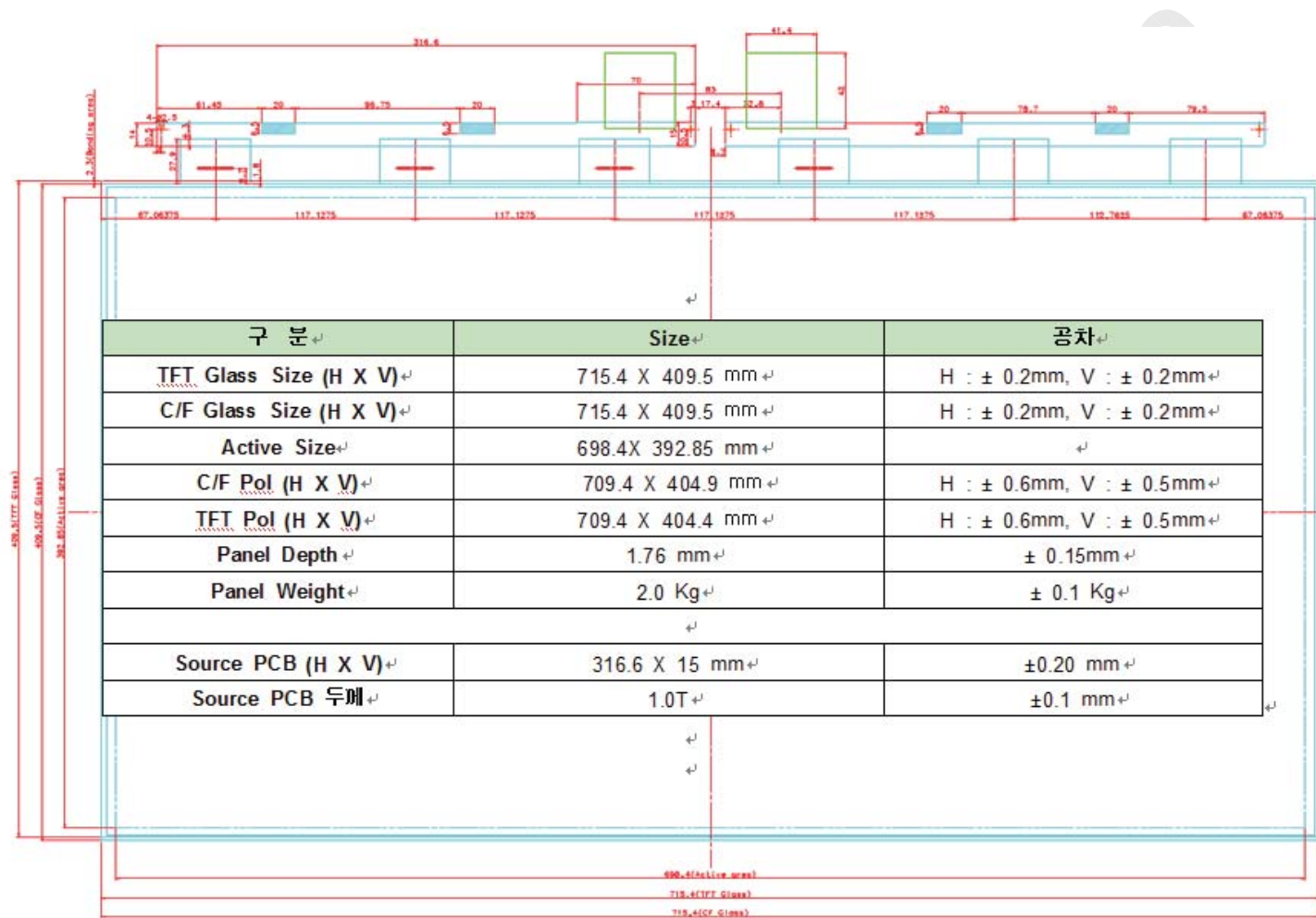T3 : The time from valid data off to V_{DD} off at power Off.
T4 : V_{DD} off time for Windows restart
T5 : The time from valid data to B/L enable at power ON.
T6 : The time from valid data off to B/L disable at power Off.

- The supply voltage of the external system for the Module input should be the same as the definition of V_{DD}.
- Apply the lamp voltage within the LCD operation range. When the back light turns on before the LCD operation or the LCD turns off before the back light turns off, the display may momentarily show abnormal screen.
- In case of V_{DD} = off level, please keep the level of input signals low or keep a high impedance.
- T4 should be measured after the Module has been fully discharged between power off and on period.
- Interface signal should not be kept at high impedance when the power is on.

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8. Outline Dimension

구 분	Size	공차
TFT Glass Size (H X V)	715.4 X 409.5 mm	H : ± 0.2mm, V : ± 0.2mm
C/F Glass Size (H X V)	715.4 X 409.5 mm	H : ± 0.2mm, V : ± 0.2mm
Active Size	698.4X 392.85 mm	
C/F Pol (H X V)	709.4 X 404.9 mm	H : ± 0.6mm, V : ± 0.5mm
TFT Pol (H X V)	709.4 X 404.4 mm	H : ± 0.6mm, V : ± 0.5mm
Panel Depth	1.76 mm	± 0.15mm
Panel Weight	2.0 Kg	± 0.1 Kg
Source PCB (H X V)	316.6 X 15 mm	±0.20 mm
Source PCB 두께	1.0T	±0.1 mm

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9. Reliability Test

Item	Test condition	Quantity
Temperature Step stress	-20℃ ~ 60℃, 10Cycle, 80hr	4EA
HTOL	50℃ operation,1000hr	8EA
LTOL	0℃ operation, 1000hr	4EA
RTOL	25℃,	4EA
HTS	70℃ storage, 500hr	4EA
LTS	-30℃ storage, 500hr	4EA
THB	40℃ / 95%RH, 30sec On / Off , 500hr operation	4EA
WHTS	60℃ / 75%RH, 500hr	4EA
ESD (operation)	contact : ±8 kV ,150pF/330Ω,200Point,1time/Point non-contact : ±15 kV,150/330Ω,200Point,1 time/Point	3EA
ESD (Non-operation)	C D M : ±10 kV,150pF/330Ω,9Point,3 time/Point	3EA
T/C	-20 ℃ ~ 60 ℃, 200Cycle	4EA
POWER ON/OFF	30sec(on) / 30sec(off) : 12,000 time)	4EA

[Result Evaluation Criteria]

Under the display quality test conditions with normal operation state, these should be no change which may affect practical display functions.

*   HTOL/ LTOL : High/Low Temperature Operating Life
** THB   : Temperature Humidity Bias
*** HTS/LTS   : High/Low Temperature Storage
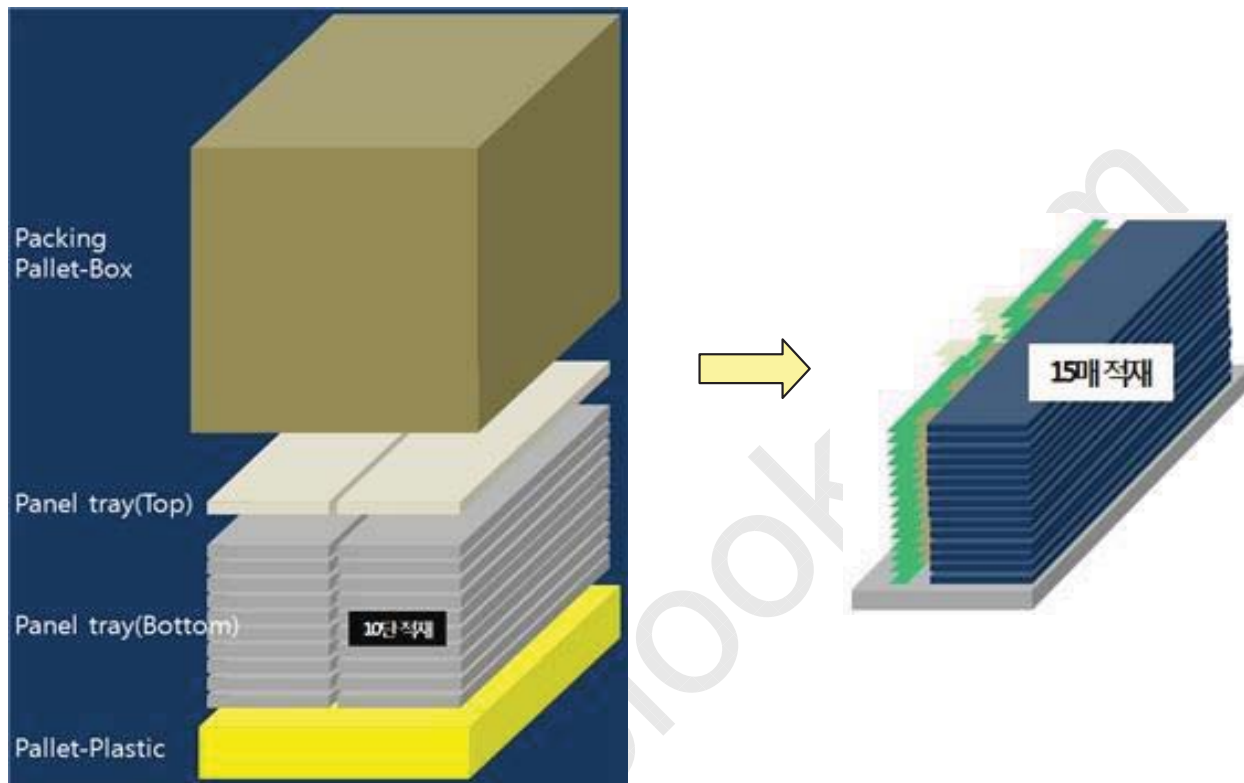**** WHTS   : Wet High Temperature Storage

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10. PACKING

10.1 CARTON (Internal Package)

(1) Packing Form

Corrugated fiberboard box and PCABS tray as shock absorber

(2) Packing Method

10.2 Packing Specification

Tray spec

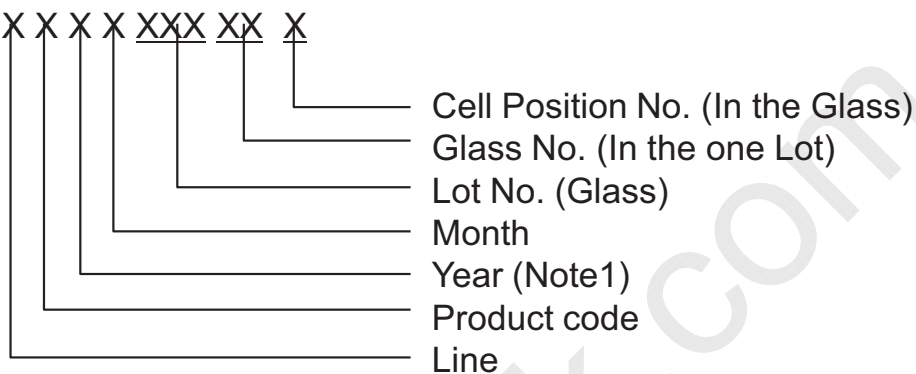| ITEM	Specification	Remark
LCD Packing	300ea / Box	1. 1.1 Kg / LCD (15[ea]/Tray, 300[ea]/Pallet) 2. 0.04 Kg / Middle sheet (18[ea]/Tray, 360[ea]/Pallet) 3. 2.00 Kg / Panel tray-Bottom (20ea/Pallet) 4. 0.50 Kg / Panel tray-Top (2ea)
Pallet-Plastic	1Box / Pallet (W1200,L850,H120, YELLOW)	1. 23 Kg / Pallet-Plastic (1ea) 2. 2.00 Kg / Packing Pallet-Box (1ea)
Packing Direction	Vertical	
Pallet size	H x V x height	1475mm(H) x 1150mm(V) x 1131mm(height)
Pallet weight	410.2 kg	Pallet(23kg) + Panel tray-Bottom(40.0kg) + Panel(330kg) + Middle sheet(14.2Kg) + Panel tray-Top (1.0kg) + Packing Pallet-Box(2.0kg)

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10.3 Middle Sheet Specification

ITEM		Specification
Measurement Condition	Temperature	25℃
	Humidity	20% ~ 60%
Sheet Size		1665.2(H) x 1017.0(V) x 1.0(D) mm
Material		Polyethylene
Surface Resistance		$10^6 \sim 10^{9.9}$ Ω
Frictional Voltage	Static (No Friction)	Less than 200V
	Dynamic (Friction : 5times at once)	Less than 500V

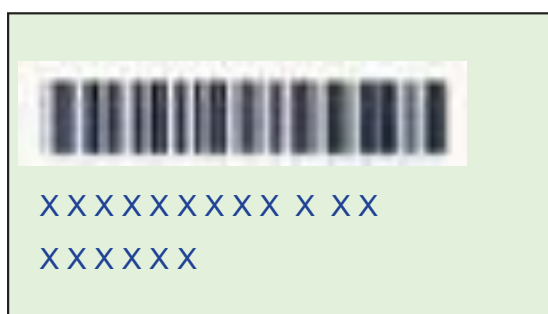| MODEL	LSJ320HN01	Doc. No	07-001-S-110119	Page	**22/27**

11. MARKING & OTHERS

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

  (1) Part number : LSJ320HN01
  (2) Revision: One letter
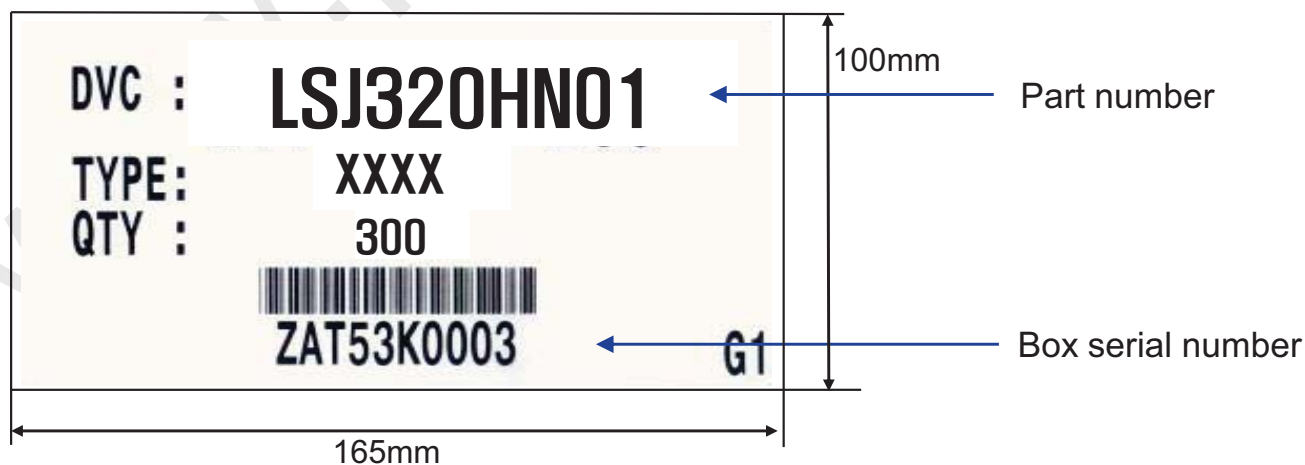 (3) Control: One letter
  (4) Lot number : X X X X XXX XX X

               Cell Position No. (In the Glass)
               Glass No. (In the one Lot)
               Lot No. (Glass)
               Month
               Year (Note1)
               Product code
               Line

  (4) Control PBA

X X X X X X X X X X X X

X X X X X X

 -Color: Green

  (5) Packing box attach

DVC : **LSJ320HN01**   100mm   Part number

TYPE: **XXXX**

QTY : **300**

ZAT53K0003 G1   Box serial number

165mm

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12. General Precautions

12.1 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 CCFL 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 handle a module

(o) Pins of I/F connector should not be touched directly with bare hands.

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* Process Control Standard

	Item	Management standard value and performance standard
1	Anti-static mat (shelf)	1 to 50 [Mohm]
2	Anti-static mat (floor, desk)	1 to 100 [Mohm]
3	Ionizer	Attenuate from ± 1,000V to ± 100V within 2 sec
4	Anti-static wrist band	0.8 to 10 [Mohm]
5	Anti-static wrist band entry and ground resistance	Below 1,000 [ohm]
6	Temperature	0 ～ 35℃
7	Humidity	60 to 70 [%RH]

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12.2 Storage

We highly recommend to comply with the criteria in the table below

ITEM	Unit	Min.	Max.
Storage Temperature	(℃)	5	40
Storage Humidity	(%rH)	35	75
Storage life	12 months		
Storage Condition	- The storage room should provide good ventilation and temperature control. - Products should not be placed on the floor, but on the Pallet away from a wall. - Prevent products from direct sunlight, moisture nor water; Be cautious of a build up of condensation. - Avoid other hazardous environment while storing goods. - If products delivered or kept in conditions of over the storage period of 3 months, the recommended temperature or humidity range, we recommend you leave them at a temperature of 20℃ and a humidity of 50% for 24 hours.		

12.3 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 lamp(CCFT) and may require higher startup voltage(Vs).

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12.4 Operation Condition Guide

(a) The LCD product should be operated under normal conditions.
Normal condition is defined as below;
- Temperature : $20\pm15℃$
- Humidity : $55\pm20\%$
- 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.

12.5 Others

(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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