Product Information

SAMSUNG
ELECTRONICS

Customer :   DATE : 24.Mar.2006

SAMSUNG TFT-LCD

MODEL : LTA460HS-L01

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

NOTE :

Customer's Approval	APPROVAED BY	DATE
	Kyunghwan Ko	24.Mar.2006
SIGNATURE	DATE	PREPARED BY	DATE
		Jeong-Geun Han	24.Mar.2006

LCD Application Engineering 3, TCS Team

Samsung Electronics Co . , LTD.

wise view™
SAMSUNG TFT-LCD

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* Revision History

Date	Rev. No	Page	Summary
Mar 24, 2006	000	all	First issued

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General Description

Description

 LTA460HS-L01 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 46.0" 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, Display terminals for AV application products, and High Definition TV (HDTV).

Features

- RoHS compliance (Pb-free)
- High contrast ratio, high aperture ratio, fast response time
- SPVA(Super Patterned Vertical Align) mode
- Wide viewing angle ($\pm$178°)
- High speed response
- Wide UXGA (1920 x 1080 pixels) resolution (16:9)
- Low Power consumption
- Direct Type 24 CCFTs(Cold Cathode Fluorescent Tube)
- DE(Data Enable) mode
- LVDS (Low Voltage Differential Signaling) interface (2pixel/clock)

General Information

Items	Specification	Unit	Note
Module Size	1083.0(H_{TYP}) x 627.0(V_{TYP})	mm	$\pm$1.0mm
	57.5(D_{MAX})		
Weight	18,000(Max.)	g	
Pixel Pitch	0.53025(H) x 0.17675(W)*3	mm	
Active Display Area	1018.08(H) x 572.67(V)	mm	
Surface Treatment	Haze 44% , Hard-coating (3H)		
Display Colors	8 bit - 16.7M	colors	
Number of Pixels	1920 x 1080	pixel	
Pixel Arrangement	RGB vertical stripe		
Display Mode	Normally Black		
Luminance of White	450 (Typ.)	cd/㎡	

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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	*5.5*	V	(1)
Storage temperature		T_{STG}		-20	60	℃	(2)
Glass surface temperature (Operation)	Center	T_{OPR}		0	50	℃	(2),(5)
	T. Uniformity	$\triangle T$		-	10	℃	
Shock (non - operating)		S_{nop}	x,y	-	50	G	(3)
			z	-	30		
Vibration (non - operating)		V_{nop}		-	1.5	G	(4)

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. Maximum wet-bulb temperature at 39 °C or less. (Ta ≤ 39 °C)
　　c. No condensation
(3) 11ms, sine wave, one time for ±X, ±Y, ±Z axis
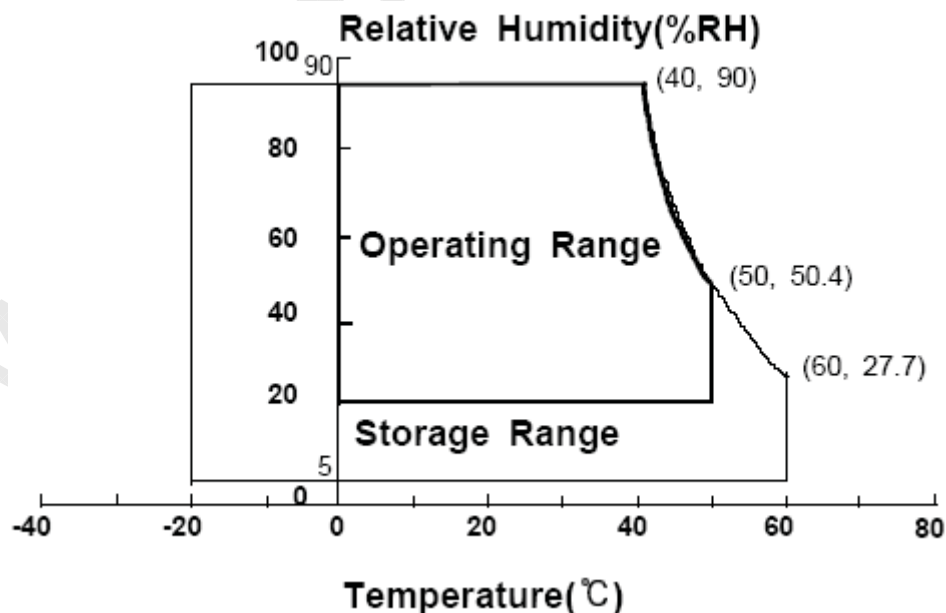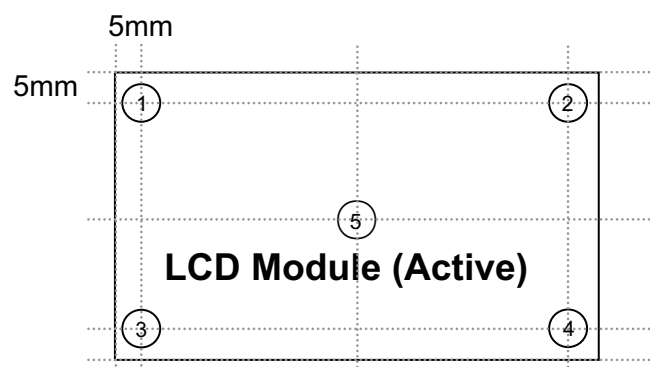(4) 10-300 Hz, Sweep rate 10min, 30min for X,Y,Z axis

Fig. Temperature and Relative humidity range

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(5) Definition of test point

5mm

5mm

LCD Module (Active)

①　②　⑤　③　④

$\triangle$T should be less than $10\ °C$ ($\triangle$T = | T_{OPR} − T_{MAX}|)

T_{OPR} : Temperature of the center of the glass surface (Test point 5)
T1~ T4 : Temperature of each edge of the glass surface
T_{MAX} : The highest temperature of the glass surface

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2. Optical Characteristics

The optical characteristics should be measured in a dark room or equivalent.
Measuring equipment : TOPCON BM-7,SPECTRORADIOMETER SR-3

(Ta = 25 $\pm$ 2°C, VDD=5V, fv= 60Hz, f_{DCLK}=74.25MHz, I_L = 6.0mArms)

Item		Symbol	Condition	Min.	Typ.	Max.	Unit	Note
Contrast Ratio (Center of screen)		C/R		800	1200	-		(3) SR-3
Response Time	Rising	Tr		-	8	10	Msec	(5) BM-7
	Falling	Tf		-	6	10		
	G-to-G	Tg		-	8	-		
Luminance of White (Center of screen)		Y_L	Normal θL,R=0 θU,D=0 Viewing Angle	400	450	-	cd/m^2	(6) SR-3
Color Chromaticity (CIE 1931)	Red	Rx		TYP. -0.03	0.648	TYP. +0.03		(7),(8) SR-3
		Ry			0.333			
	Green	Gx			0.271			
		Gy			0.592			
	Blue	Bx			0.141			
		By			0.066			
	White	Wx			0.280			
		Wy			0.290			
Color Gamut		-		-	72	-	%	(7) SR-3
Color Temperature		T		-	10000	-	K	(7) SR-3
Viewing Angle	Hor.	θ_L	C/R≥10	75	89	-	Degree	(8) SR-3
		θ_R		75	89	-		
	Ver.	θ_U		75	89	-		
		θ_D		75	89	-		
Brightness Uniformity (9 Points)		B_{uni}		-	-	25	%	(4) SR-3

Note (1) 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.

Single lamp current : 6.0mA
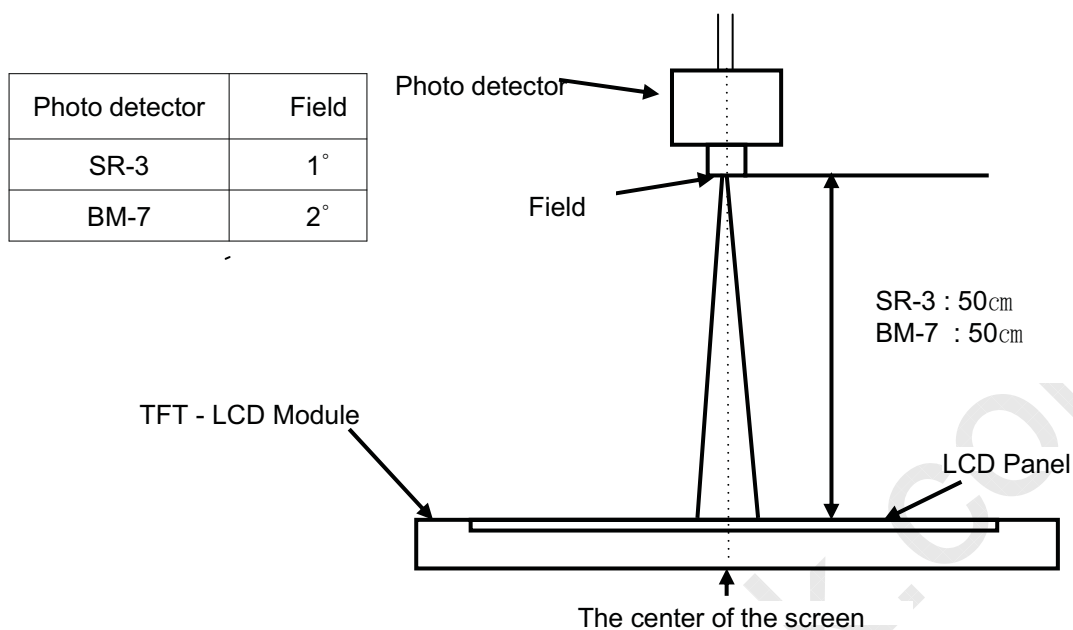Environment condition : Ta = 25 $\pm$ 2 °C
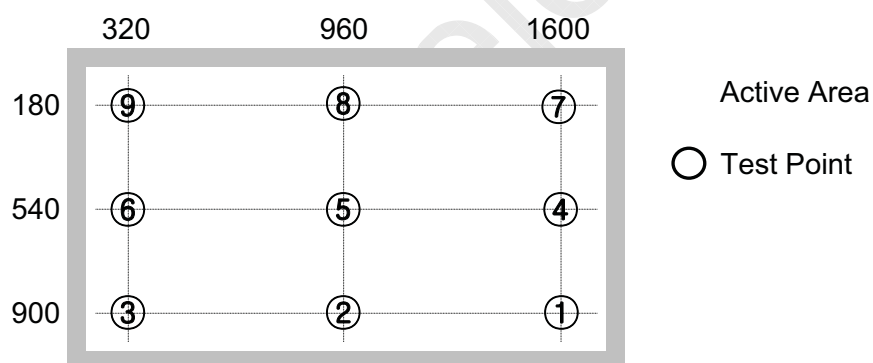
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Photo detector	Field
SR-3	1°
BM-7	2°

Photo detector

Field

SR-3 : 50㎝
BM-7 : 50㎝

TFT - LCD Module

LCD Panel

The center of the screen

Note (2) Definition of test point

Active Area

○ Test Point

Note (3) Definition of Contrast Ratio (C/R)
 : Ratio of gray max (Gmax) & gray min (Gmin) at the center point ⑤ of the panel

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

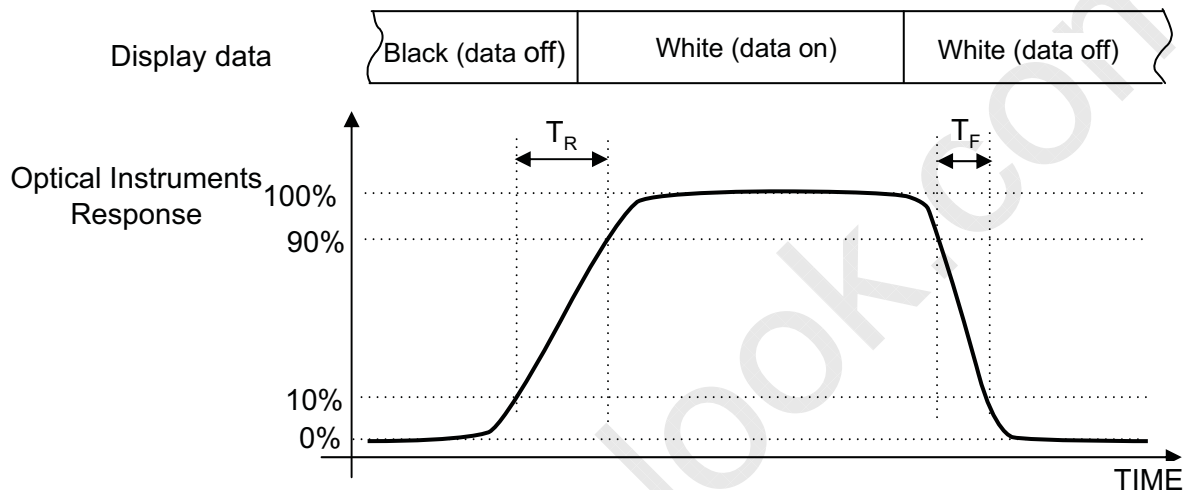Gmax : Luminance with all pixels white
Gmin : Luminance with all pixels black

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Note (4) Definition of 9 points brightness uniformity

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

        Bmax : Maximum brightness
        Bmin : Minimum brightness

Note (5) Definition of Response time : Sum of Tr, Tf

Display data | Black (data off) | White (data on) | White (data off) |

Optical Instruments Response

100%
90%

10%
0%

T_R T_F

TIME

Note (6) Definition of Luminance of White : Luminance of white at center point ⑤

Note (7) Definition of Color Chromaticity (CIE 1931)
       Color coordinate of Red, Green, Blue & White at center point ⑤

Note (8) Definition of Viewing Angle
      : Viewing angle range (C/R ≥10)

Θ_U

Θ_R

Θ_L

Θ_D

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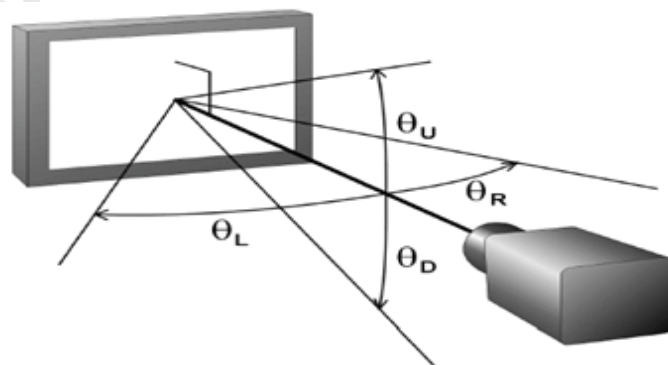
3. Electrical Characteristics

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}	4.5	5.0	5.5	V	(1)
Current of Power Supply	(a) Black	I_{DD}	-	2300	-	mA	(2),(3)
	(b) White		-	2750	-	mA	
	(c) N-Pattern		-	3600	4500	mA	
Vsync Frequency		f_V	-	60	-	Hz	
Hsync Frequency		f_H	65.5	67.5	-	kHz	
Main Frequency		f_{DCLK}	65.5	74.25	83.4	MHz	
Rush Current		I_{RUSH}	-	-	12	A	(4)

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

(2) f_V=60Hz, f_{DCLK} = 74.25MHz, V_{DD} = 5.0V, DC Current.

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

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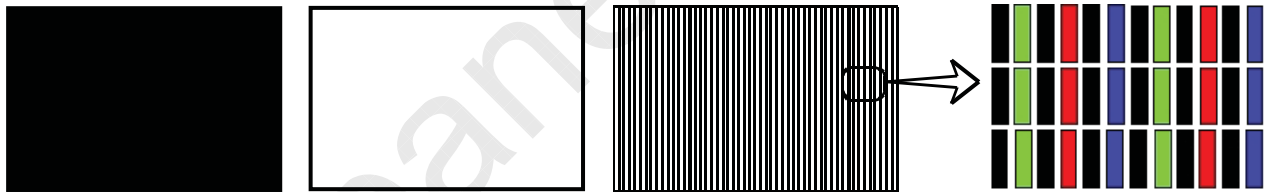
(4) Measurement Conditions

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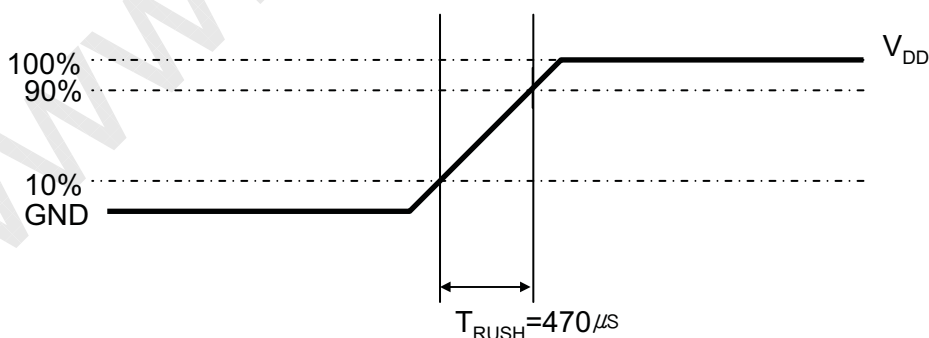
Rush Current I_{RUSH} can be measured when T_{RUSH}. is 470μs.

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3.2 Back Light Unit

The back light unit contains 24 direct-lighting type CCFTs (Cold Cathode Fluorescent Tube). The characteristics of lamps are shown in the following tables.

Ta=25 $\pm$ 2°C

Item	Symbol	Min.	Typ.	Max.	Unit	Note
Lamp Current	I_L	4.0	6.0	7.0	mArms	
Lamp Voltage	V_L	-	1780	-	Vrms	
Operating Life Time	Hr	50,000	-	-	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$\pm$2℃, IL = 6.0mArms(typ.), For single lamp only.]
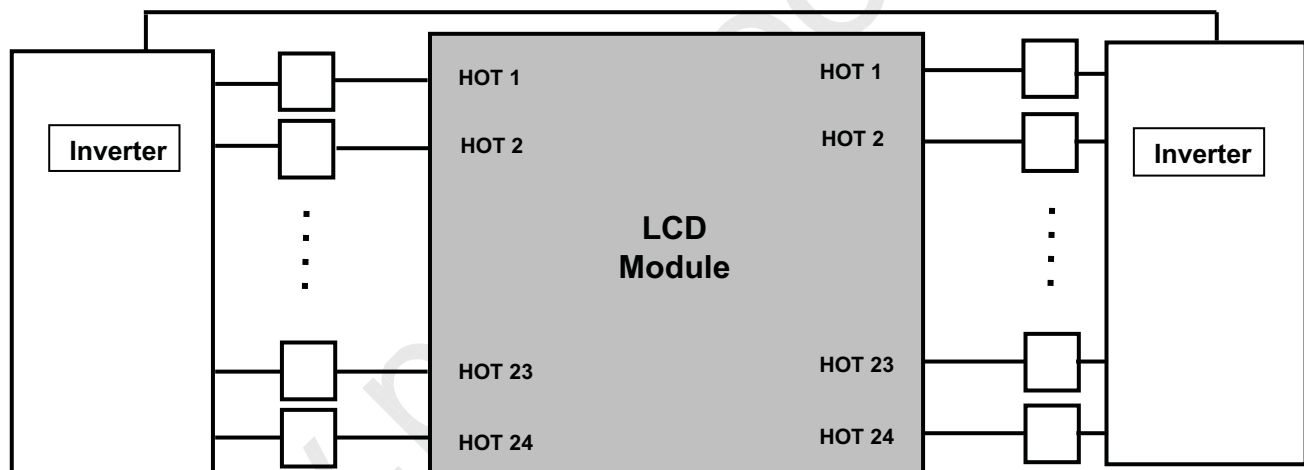
3.3 Inverter Input Condition & Specification

Items	Symbol	Conditions	Specifications			Unit	Note
			Min.	Typ.	Max.		
Input Voltage	Vin	-	21.6	24	26.4	V	Ta=25±2 °C
Input Current	I_{RUSH}	Vin=24.0V Vdim=3.3V	-	-	10.01	A	Initial Turn-on
Lamp Current	I_O	Vdim=3.3 V	5.5	6.0	6.5	mArms	-
Frequency	F_{LAMP}	Vin=24.0 V	55	60	65	kHz	-
Backlight On/Off	ON	Vin=24.0 V	2.4	-	5.25	V	-
	OFF	Vin=24.0 V	0	-	0.8		
Dimming Control	V_{DIM}	Max Lum	2.5	-	-	V	-
		Min. Lum	-	-	0		

4. Block Diagram

CONTROL PCB

SSC

USER CONNECTOR

TIMING CONTROLLER

DC/DC STEP DOWN

MEMORY(DCC)

DC/DC CONVERTOR
(AV$_{DD}$/V$_{DD}$/V$_{ON}$/V$_{OFF}$)

FPC

SOURCE PCB

DATA DRIVER IC

LTA460HS PANEL

GAMMA-GENERATOR

V$_{COM}$-GENERATOR
R-STRING + FB

FPC

SOURCE PCB

DATA DRIVER IC

GATE DRIVER IC

→ DATA
→ CONTROL
→ V$_{IN}$(5.0V)
→ AV$_{DD}$
→ V$_{ON}$/V$_{OFF}$
→ V$_{COM}$
→ Y VOLTAGE
→ V$_{DD}$(3.3V)
→ V$_{DD}$(2.5V)

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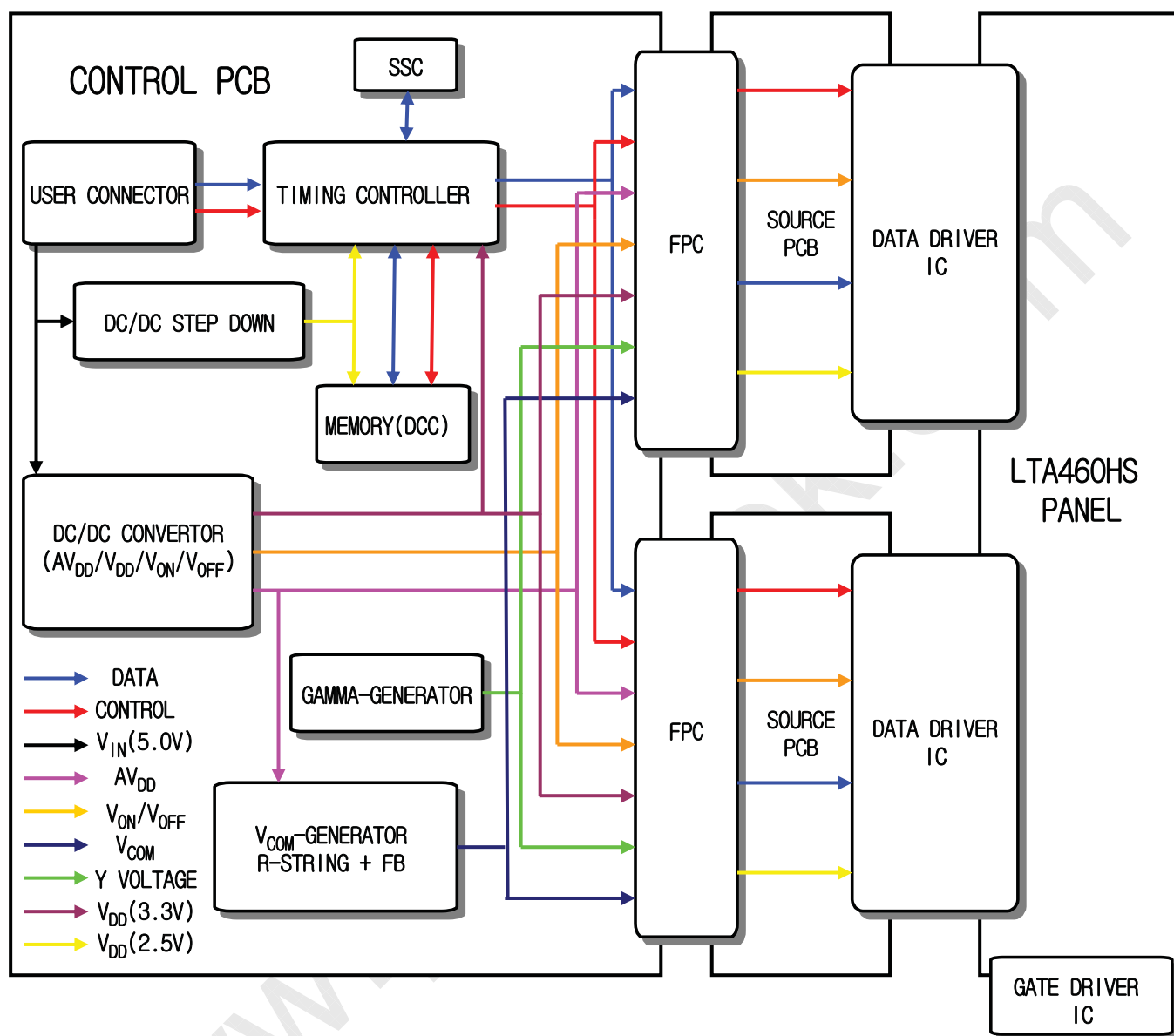
5. Input Terminal Pin Assignment

5.1. Input Signal & Power   Connector : FI-E30S (JAE)

No	Signal	No	Signal
1	RxInO0-	16	RxInE2+
2	RxInO0+	17	RxInECLK-
3	RxInO1-	18	RxInECLK+
4	RxInO1+	19	RxInE3-
5	RxInO2-	20	RxInE3+
6	RxInO2+	21	GND
7	RxInOCLK-	22	GND
8	RxInOCLK+	23	GND
9	RxInO3-	24	GND
10	RxInO3+	25	GND
11	RxInE0-	26	Vin
12	RxInE0+	27	Vin
13	RxInE1-	28	Vin
14	RxInE1+	29	Vin
15	RxInE2-	30	Vin

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Note(1) Pin number starts from Right side

Pin No. 1   Pin No. 30

connect name
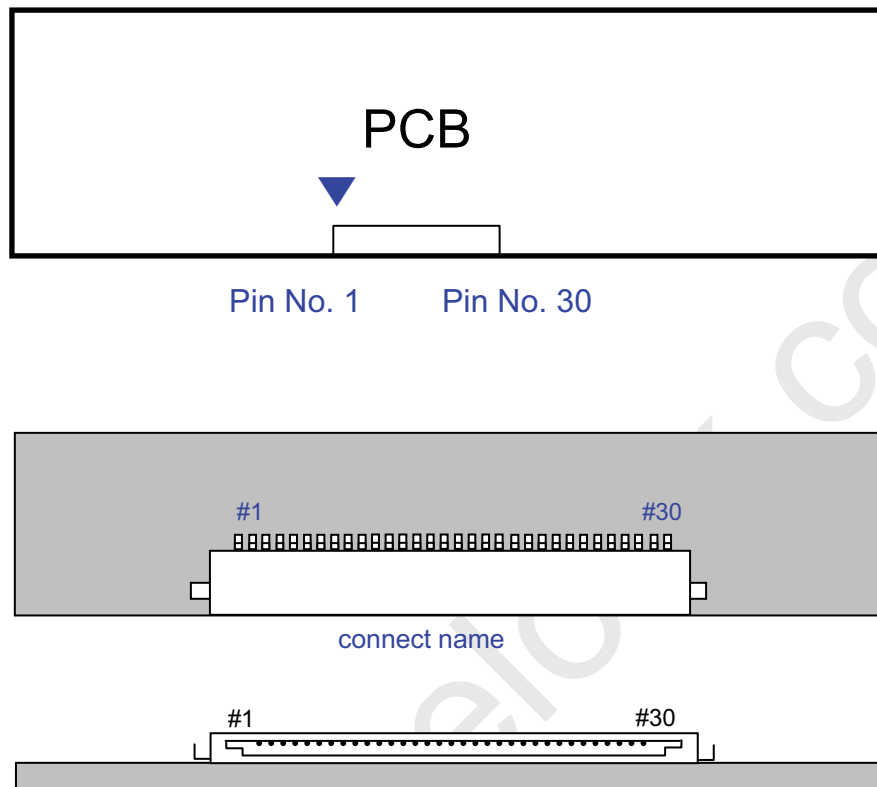
Fig. Connector diagram

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

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5.2. Inverter Input Pin Configuration

Connector : S14B-PHA-SM-TB(LF) (JST)

Pin No.	Pin Configuration(FUNCTION)
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	No Connection * ERROR DETECTION (NORMAL : GND / ABNORMAL : 5V)
12	Backlight On /Off [ON:2.4 - 5.25 V, OFF: 0 - 0.8 V]
13	Dimming Control [0V:Min, 2.5V:Max]
14	No Connection

5.3. Inverter Input Power Sequence

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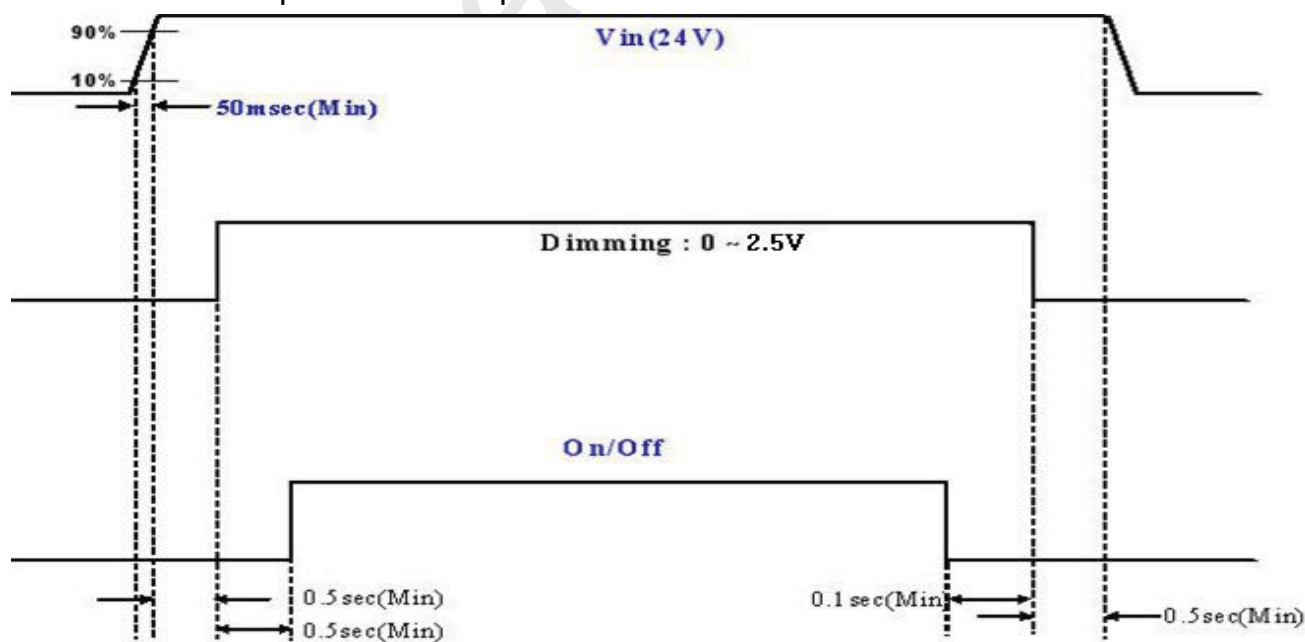
5.4 LVDS Interface
  - LVDS Receiver : Tcon (merged)
  - Data Format (JEIDA & Normal)

	LVDS pin	JEIDA -DATA	VESA -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

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

COLOR	DISPLAY (8bit)	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
	↓	:	:	:	:	:	:			:	:	:	:	:	:	:	:	:	:	:	:	:	:			
	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	R252
		0	1	1	1	1	1	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	R252
	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	R252
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	G252
		0	0	0	0	0	0	0	0	0	1	1	1	1	1	1	1	0	0	0	0	0	0	0	0	G252
	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	G252
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	B252
		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1	1	1	1	1	1	B252
	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	B252

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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6. Interface Timing

6.1 Timing Parameters （DE only mode）

SIGNAL	ITEM	SYMBOL	MIN.	TYP.	MAX.	Unit	NOTE
Clock	Frequency	$1/T_C$	65.5	74.25	83.4	MHz	-
Hsync		F_H	65.5	67.5	-	KHz	-
Vsync		F_V	-	60	-	Hz	-
Vertical Display Term	Active Display Period	T_{VD}	-	1080	-	lines	-
	Vertical Total	T_{VB}	1092	1125	1158	lines	-
Horizontal Display Term	Active Display Period	T_{HD}	-	1920	-	clocks	-
	Horizontal Total	T_H	2000	2200	2400	clocks	-

Note) This product is DE only mode. The input of Hsync & Vsync signal does
not have an effect on normal operation.
(1) Test Point : TTL control signal and CLK at LVDS Tx input terminal in system
(2) Internal V_{DD} = 3.3V

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6.2 Timing diagrams of interface signal (DE only mode)
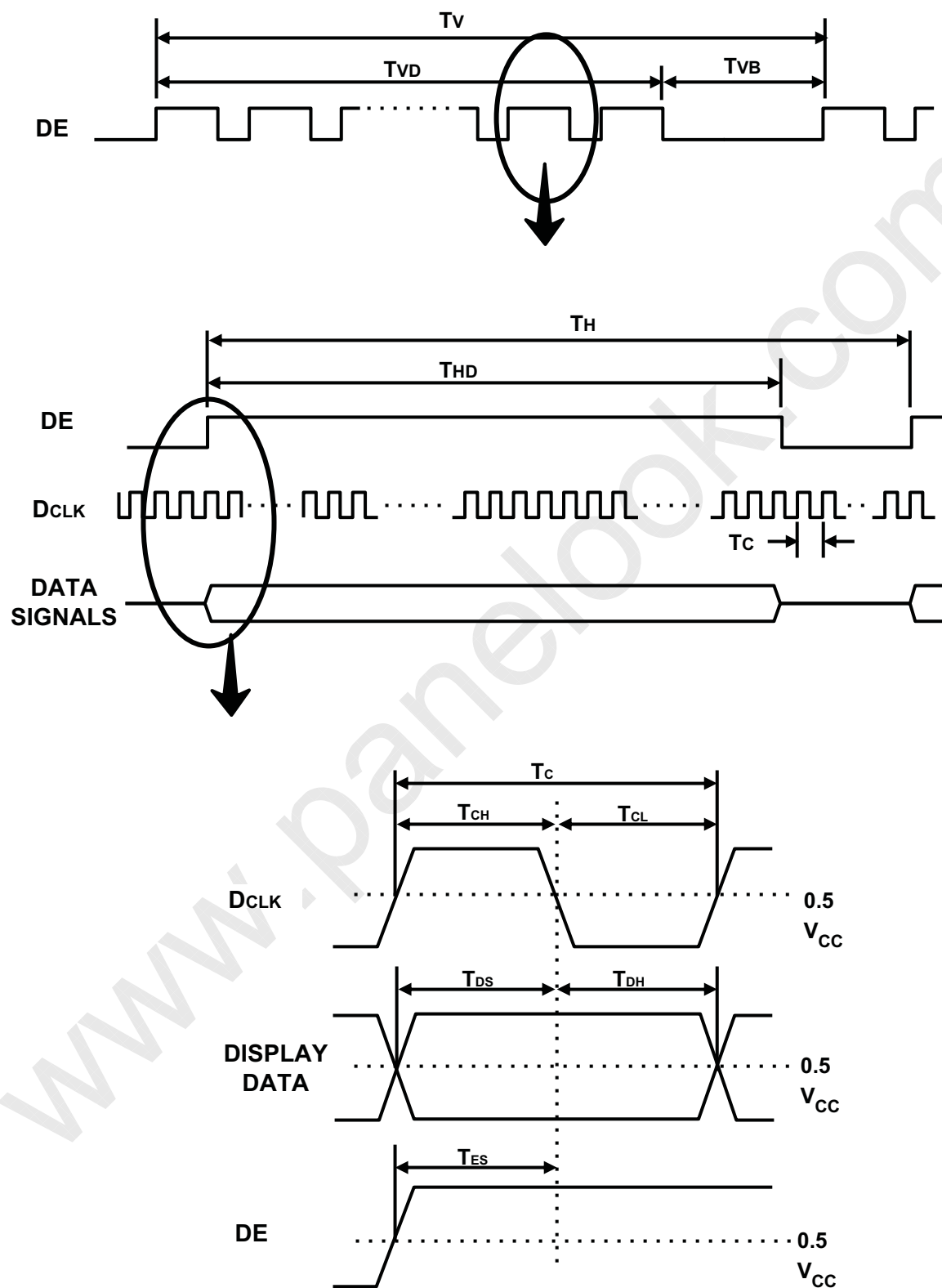
6.3 Power ON/OFF Sequence

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

Power Supply V_{DD}

0.9 V_{DD}
0.1 V_{DD}
0V

0<T1≤10msec
0<T2≤50msec
0<T3≤50msec
1000msec≤T4

Signals   0 V

Power On   Power Off

1000msec≤T5
(Recommend Value)
100msec≤T6
(Recommend Value)

2.4 V
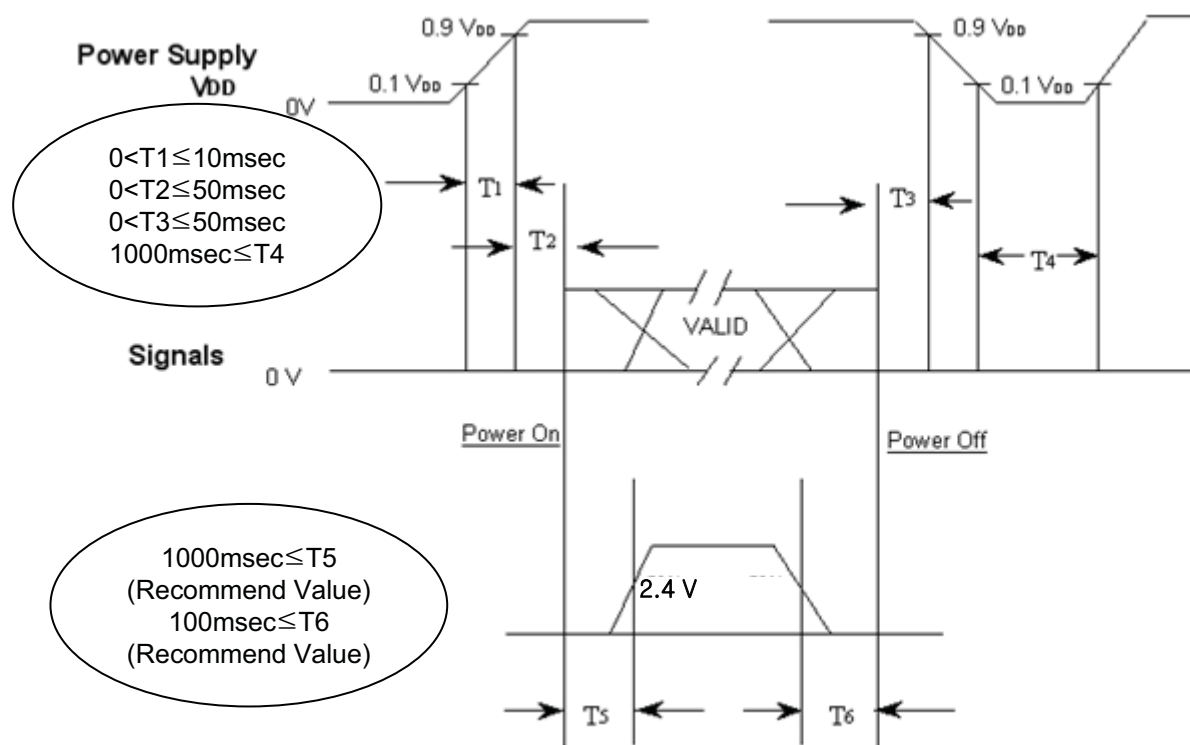
T1 : V_{DD} rising time from 10% to 90%
T2 : The time from V_{DD} to valid data at power ON.
T3 : The time from valid data off to V_{DD} off at power Off.
T4 : V_{DD} off time for Windows restart
T5 : The time from valid data to B/L enable at power ON.
T6 : The time from valid data off to B/L disable 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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7. Outline Dimension (Front View)

NOTES

1. BACKLIGHT : 24 COLD CATHODE FLUORESCENT LAMPS.
2. I/F CONNECTOR SPECIFICATION.(30PIN)
   - MAKER : JAE.
   - PART NO. : FI-E30S
3. INVERTOR CONNECTOR SPECIFICATION.(14PIN, 2EA)
   - MAKER : JST(YEDANG)
   - PART NO. : S14B-PH-SMD-TB(/20022WP-14AWL)
4. LAMP WIRE SPEC.
   - UL3239Y AWG24 DDRKV.#1,74,PINK
   - UL3239Y AWG24 DDRKV.#1,74,PINK
5. USER HOLE : ALLIGNED DEPTH FROM(USERHOLE SCREEN
   INSERTION FROM CHASSIS)IS 7.0mm MAX.
   (NOT CONSIDERING USER BRACKET)
6. GAP BETWEEN TOP CHASSIS AND GLASS IS 1.4mm MAX.
7. WEIGHT : Max 16.5 Kg
8. BLACK MATRIX SPEC.
   - IA : IA ≤ 2.0 mm
   - IC : IOI ≤ 2.0 mm

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	±0.1	±0.25	±0.4
64 < x ≤ 256	±0.15	±0.25	±0.8

SAMSUNG ELECTRONICS

LTA460HS-L02
OUTLINE DIMENSION

7. Outline Dimension (Rear View)

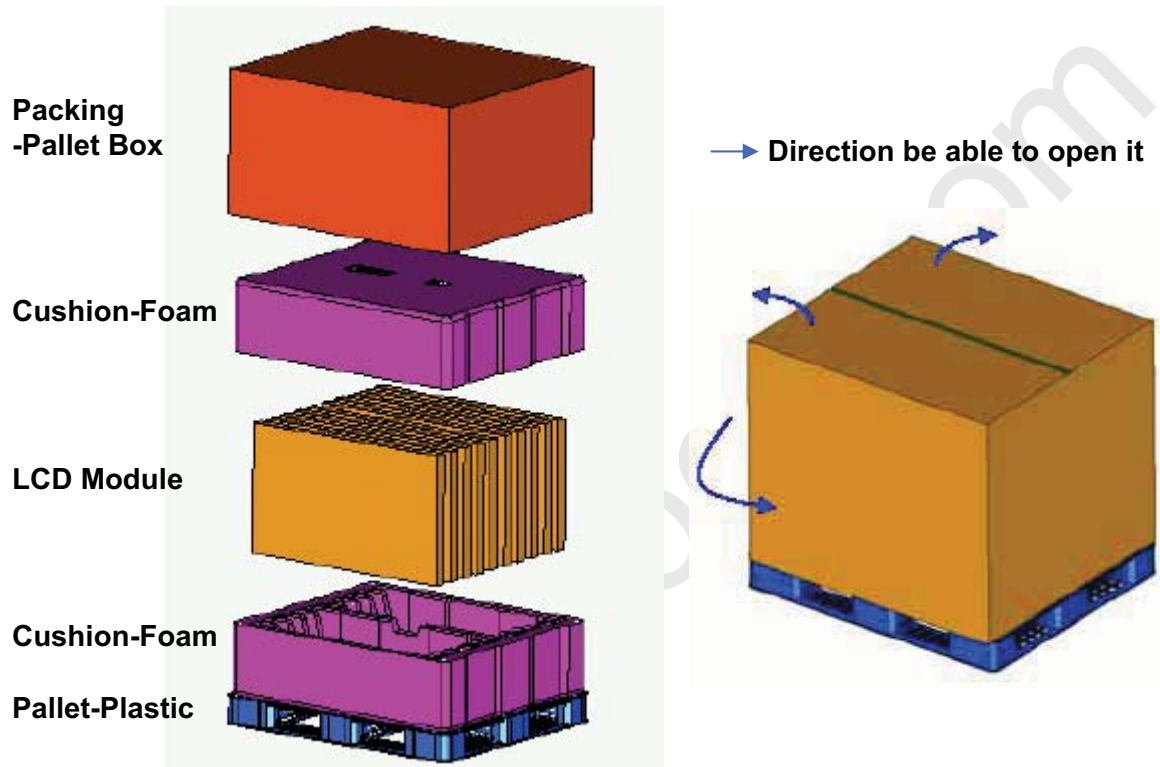| Model	Doc. No	Page
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8. PACKING

8.1 CARTON (Internal Package)
(1) Packing Form
Corrugated fiberboard box and corrugated cardboard as shock absorber
(2) Packing Method

Packing -Pallet Box

Cushion-Foam

LCD Module

Cushion-Foam

Pallet-Plastic

→ **Direction be able to open it**

8.2 Packing Specification

Item	Specification	Remark
LCD Packing	10ea / (Packing-Pallet Box)	1. 170 Kg / LCD (10ea) 2. 10 Kg / Cushion-pallet (2ea) 3. 8 Kg / Packing-Pallet Box (1ea) 4. Cushion-pallet Material : EPS 5. Packing-Pallet Box Material : DW4
Pallet	1Box / Pallet	1. Pallet weight = 8.8kg 2. 8.8Kg/Pallet
Packing Direction	Vertical	
Total Pallet Size	H x V x height	1270mm(H) x 1150mm(V) x 844mm(height)
Total Pallet Weight	197kg	Pallet(8.8kg) + Module(17*10=170) + Cushion(up+botton=10kg) + Pallet-BOX(8kg)

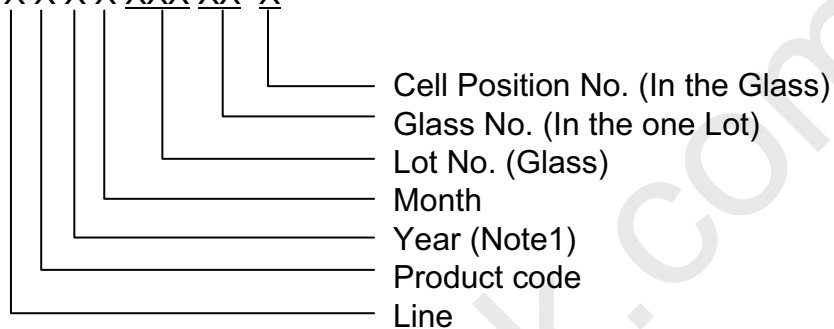| MODEL	LTA460HS-L01	Doc. No	05-000-G-060324	Page	24 / 28

9. MARKING & OTHERS

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

(1) Parts number : LTA460HS-L01
(2) Revision: Three letters
(3) 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) Nameplate Indication

LTA460HS-L01

0529

XXXXXXXXXX   XXX

MADE IN KOREA

Week code : 05 29
week
year

40mm

Revision code
Lot number

80mm

(5) Packing box attach

DVC : LTA460HS-L01
TYPE: XXXX
QTY : 10
ZAT53K0003   G1

100mm

Part number

Box serial number

165mm
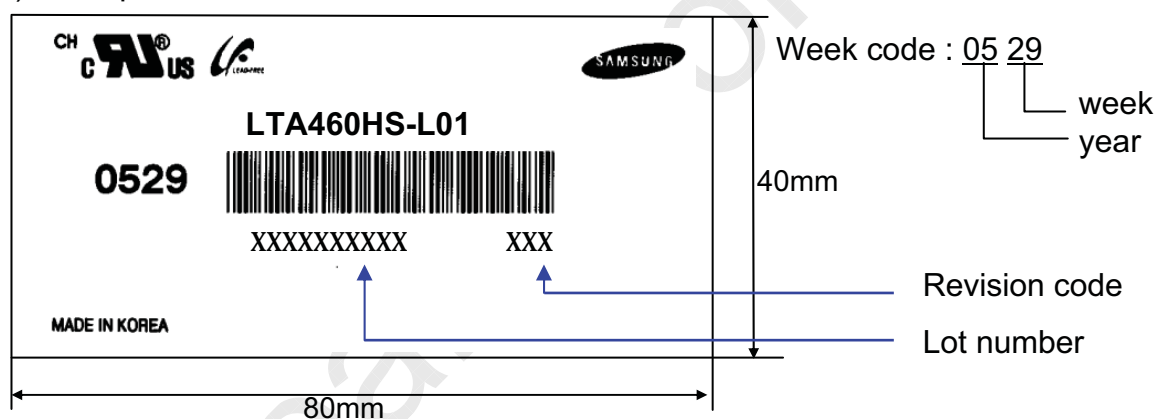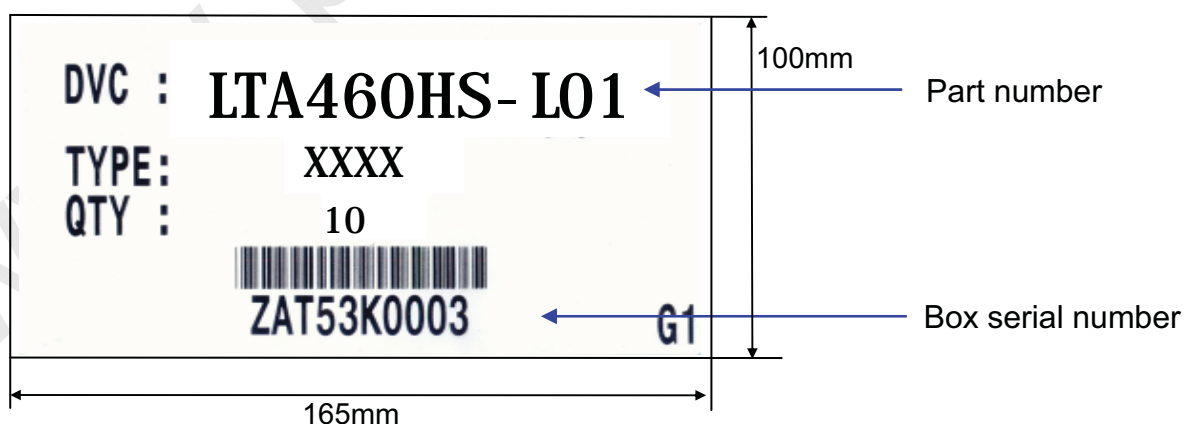
(6) Others
  1. After service part
     Lamps cannot be replaced because of the narrow bezel structure.

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10. General Precautions

10.1 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 static, or the CMOS Gate Array IC 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 pull or fold the lamp wire.

(m) Do not adjust the variable resistor located on the Module.

(n) Protection film for polarizer on the Module should be slowly peeled off just before use so that the electrostatic charge can be minimized.

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

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10.2 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℃
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.

10.3 Operation

(a) No Connection 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).

10.4 Operation Condition Guide

(a) The LCD product should be operated under normal conditions.
Normal condition is defined as below;
- Temperature : 20 ± 15℃
- Humidity : 55 ± 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.

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10.5 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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