SAMSUNG
ELECTRONICS

ISSUED DATE : 2006-12-15

SAMSUNG TFT-LCD PRODUCT INFORMATION

MODEL : LTA150XH - L06

Note : This is Product Information is subject to change after 3 months of issuing date.

Product planning Group 2

Samsung Electronics Co . , LTD.

wise view™

SAMSUNG TFT-LCD

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General Description

Description

LTA150XH-L06 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 15" is 1024 x 768 and this model can display up to 16.2 millions colors.

Features

- High contrast ratio, high aperture structure
- TN (Twisted Nematic) mode
- Wide Viewing Angle
- High speed response
- XGA (1024 x 768 pixels) resolution
- Low power consumption
- DE (Data Enable) only mode
- LVDS (Low Voltage Differential Signaling) interface (1pixel/clock)
- Compact Size Design

Applications

- TV & Desktop monitors
- Display terminals for AV application products
- Monitors for industrial machine
  * If the module is used to other applications besides the above, please contact SEC in advance.

General Information

Items	Specification	Unit	Note
Active Display Area	304.1(H) x 228.1(V)	mm	
Surface Treatment	Haze 25, Anti-glare & Hard-Coatig(3h)		
Display Colors	16.2M	colors	
Number of Pixels	1,024 x 738	pixel	
Pixel Arrangement	RGB vertical stripe		
Display Mode	Normally White		
Luminance of White	400(Typ.)	cd/m^2	

Mechanical Information

Item		Min.	Typ.	Max.	Unit	Note
Module size	Horizontal (H)	-	331.6	-	mm	
	Vertical (V)	-	254.8	-	mm	
	Depth (D)	-	12.5	-	mm	
Weight		-	-	1350	g	LCD module only

Note (1) Mechanical tolerance is $\pm$ 0.5mm unless there is a special comment.

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-0.3	3.6	V	
Data Signal	V_{sig}	-	5	V	
Storage temperature	T_{STG}	-25	60	℃	(1)
Glass surface temperature (Operation)	T_{OPR}	0	50	℃	
Shock (non - operating)	S_{nop}	-	50	G	(2)
Vibration (non - operating)	V_{nop}	-	1.5	G	(3)

Note (1) Ta= 25 $\pm$ 2 $^\circ$C

(1) Temperature and relative humidity range are shown in the figure below.
   a. 90 % RH Max. (Ta $\leq$ 39 $^\circ$C)
   b. Maximum wet-bulb temperature at 39 $^\circ$C or less. (Ta $\leq$ 39 $^\circ$C)
   c. No condensation
(2) 11ms, sine wave, one time for $\pm$X, $\pm$Y, $\pm$Z axis
(3) 10-300 Hz, Sweep rate 10min, 30min for X,Y,Z axis

**Relative Humidity (%RH)**

(39,90)
Operating
Range
(50,50.4)
(60,27.7)
(-25,5)
Storage Range
Temperature (^{O}C)
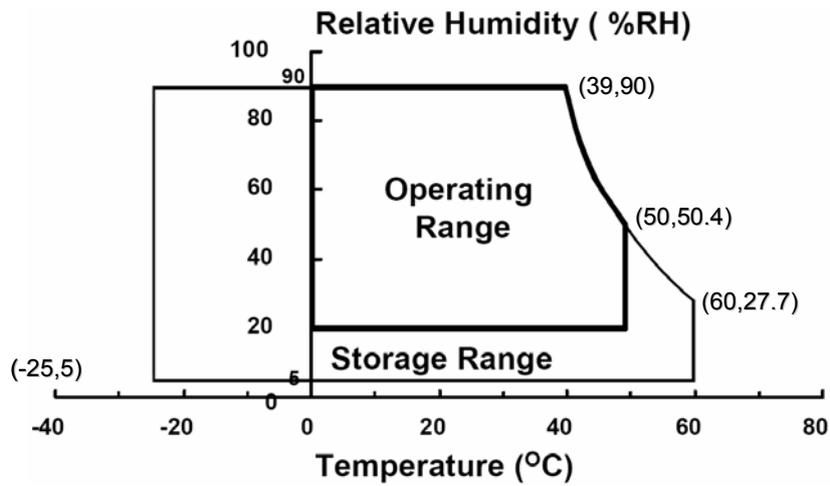
Fig. Temperature and Relative humidity range

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=3.3V, fv= 60Hz, fDCLK=65MHz, IL = 6mArms

Item		Symbol	Condition	Min.	Typ.	Max.	Unit	Note
Contrast Ratio (Center of screen)		C/R		300	400	-		(3) SR-3
Response Time	Rising	Tr		-	5	10	msec	(5) BM-7
	Falling	Tf		-	20	25		
Luminance of White (Center of screen)		Y_L		350	400	-	cd/m2	(6) SR-3
Color Chromaticity (CIE 1931)	Red	Rx	Normal $\theta_{L,R}$=0 $\theta_{U,D}$=0 Viewing Angle	-	0.624	-		(7),(8)
		Ry		-	0.356	-		
	Green	Gx		-	0.280	-		
		Gy		-	0.585	-		
	Blue	Bx		-	0.144	-		
		By		-	0.076	-		
	White	Wx		-	0.280	-		
		Wy		-	0.290	-		
Viewing Angle	Hor.	θ_L	CR$\geq$10	60	70	-	Degrees	(8) SR-3
		θ_R		60	70	-		
	Ver.	θ_U		50	60	-		
		θ_D		50	65	-		
Brightness Uniformity (9 Points)		B_{uni}		-	-	25	%	(4) SR-3

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Note (1) Test Equipment Setup

The measurement should be executed in a stable, windless and dark room between 30min 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 : 6mA
Environment condition : Ta = 25 $\pm$ 2 $^\circ$C

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
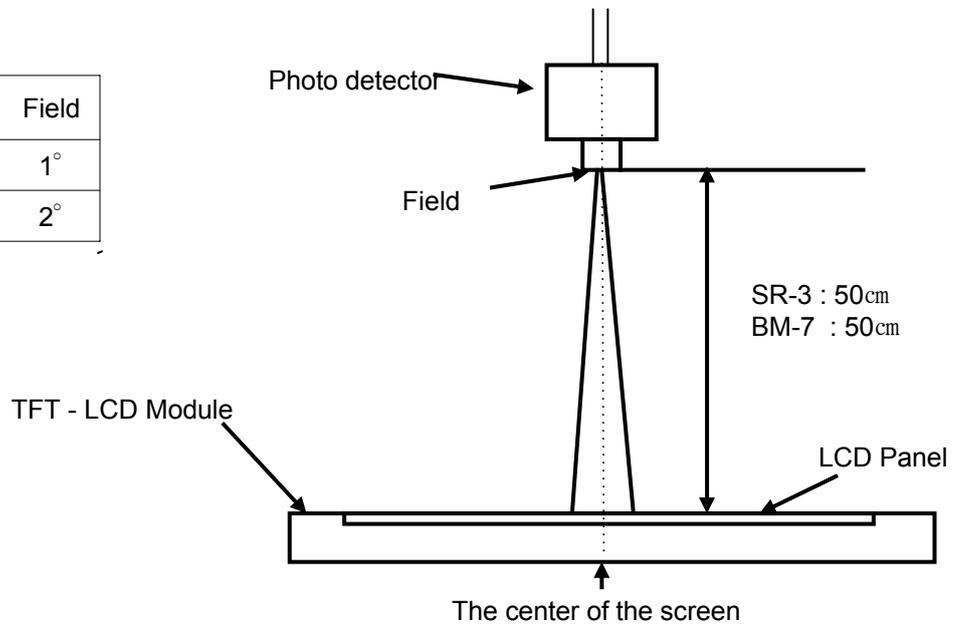
Note (2) Definition of test point

Active Area

128   640   1152

| 9 | 8 | 7 | 102
| 6 | 5 | 4 | 512
| 3 | 2 | 1 | 922

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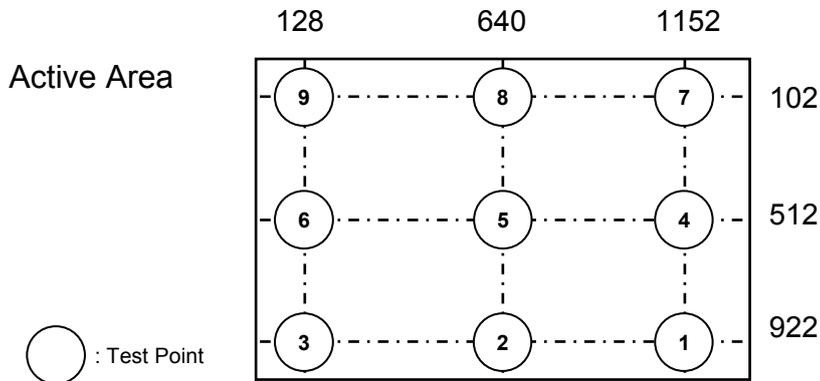
Note (3) Definition of Contrast Ratio (C/R)
: Ratio of gray max (Gmax) & gray min (Gmin) at the center point ⑤ of the panel

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

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

Note (4) Definition of 9 points brightness uniformity

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

Bmax : Maximum brightness
Bmin : Minimum brightness

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

Display Data   White(TFT off) Black(TFT on) White(TFT off)

Optical Instruments
Response

T_R T_F

100%
90%

10%
0%

TIME

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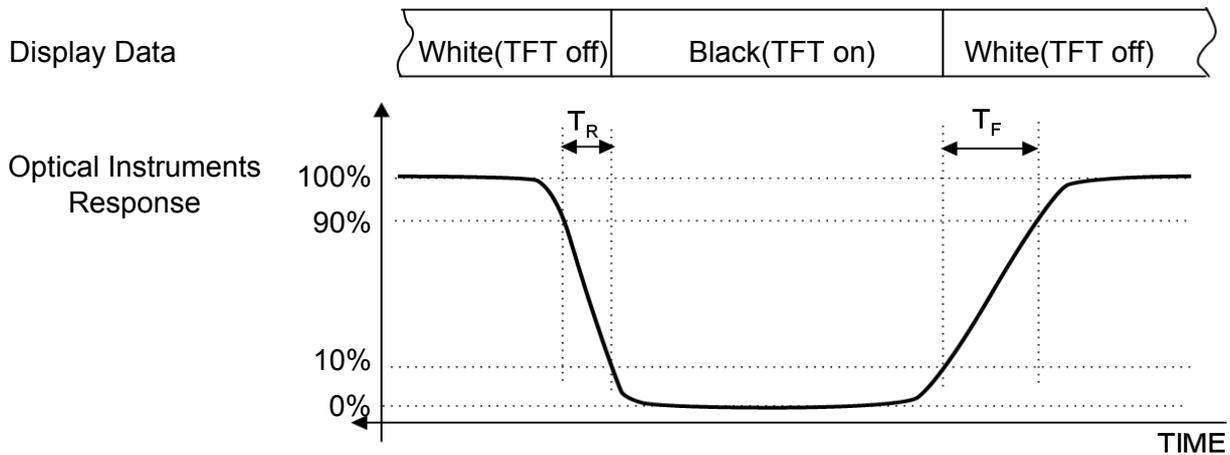
Note (6) Definition of Luminance of White : Luminance of white at center point⑤

Note (7) Definition of Color Chromaticity (CIE 1931, CIE1976)
Color coordinate of Red, Green, Blue & White at center point⑤

Note (8) Definition of Viewing Angle
: Viewing angle range (CR ≥ 10)
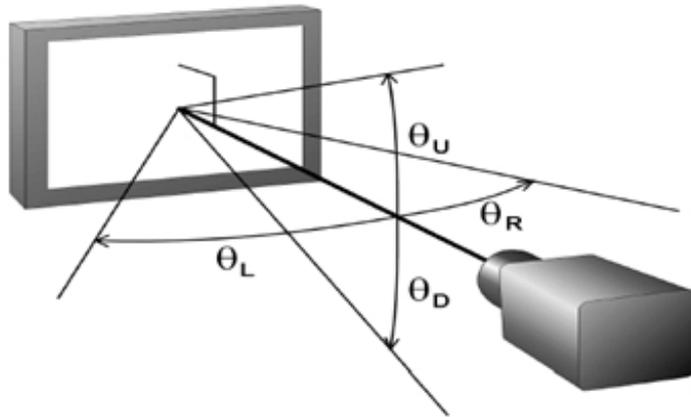
3. Electrical Characteristics

3.1 TFT LCD Module

The connector for display data & timing signal should be connected (GND=0V)

Ta = 25°C

| Item		Symbol	Min.	Typ.	Max.	Unit	Note
Voltage of Power Supply		V_{DD}	3.0	3.3	3.6	V	(1)
LVDS Input Characteristics	Differential Input Voltage for LVDS Receiver Threshold (High)	High	-	-	+100	mV	(2)
	Differential Input Voltage for LVDS Receiver Threshold (Low)	Low	-100	-	-	mV	
	LVDS skew	t_{SKEW}	-300		300		(3)
	Differential input voltage	$|V_{ID}|$	200		600	mV	(4)
	Input voltage range (single-ended)	V_{IN}	0		2.4	V	(4)
	Common mode voltage	V_{CM}	$0+|V_{ID}|/2$	1.2	$2.4-|V_{ID}|/2$	V	(4)
Current of Power Supply	White	I_{DD}	-	400	460-	mA	(5),(6)
	Mosaic		-	420	480	mA	
	Sub-pixel checker		-	470	550	mA	
Vsync Frequency		f_V	-	60	75	Hz	
Hsync Frequency		f_H	-	48.3	60.0	kHz	
Main Frequency		f_{DCLK}	47	65	80	MHz	
Rush Current		I_{RUSH}	-	-	1.5	A	(7)

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

(2) Differential receiver voltage definitions and propagation delay and transition time test circuit

      a. All input pulses have frequency = 10MHz, t_R or t_F=1ns

      b. C_L includes all probe and fixture capacitance

Inputs
Note a.

R_{IN+}

R_{IN-}

$V_{ID} = V_{IA} - V_{IB}$

V_{IA}

$|V_{IC} = (V_{IA} + V_{IB})/2|$ V_{IB}

R_{OUT}

C_L

Note b.
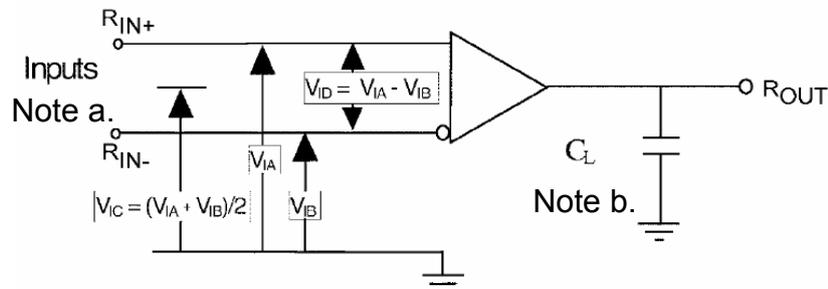
(3) LVDS Receiver DC parameters are measured under static and steady conditions which may not be reflective of its performance in the end application.

T

LVDS Clk V_{DIFF}= 0V V_{DIFF}= 0V   Differential

LVDS Data
RX +/-   Differential
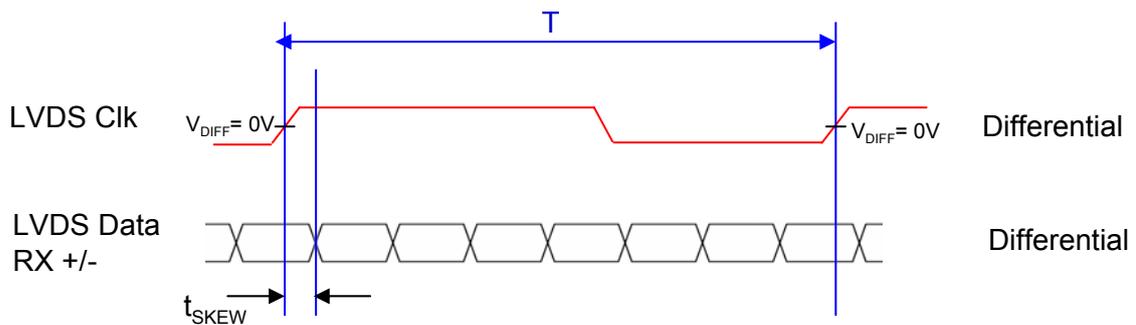
t_{SKEW}

where tskew : skew between LVDS clock & LVDS data,

      T   : 1 period time of LVDS clock

          cf) (-/+) of 380psec means LVDS data goes before or after LVDS clock.

(4) Definition of V_{ID} and V_{CM} using single-end signals

V_{CM}=2.3V   2.4V $|V_{ID}|$=200mV   2.2V

V_{CM}=2.1V   2.4V $|V_{ID}|$=600mV   1.8V

V_{CM}=1.25V   1.425V $|V_{ID}|$=350mV   1.075V

V_{CM}=100mV   200mV $|V_{ID}|$=200mV   0V

V_{CM}=300mV   0.6V $|V_{ID}|$=600mV   0V

V_{SS}

V_{CM}=(1.25V): $|V_{ID}|$=350mV
Typical Application

V_{CM}=(100mV to 2.3V): $|V_{ID}|$=200mV
V_{CM} range with Minimum $|V_{ID}|$

V_{CM}=(300mV to 2.1V): $|V_{ID}|$=600mV
V_{CM} range with Minimum $|V_{ID}|$

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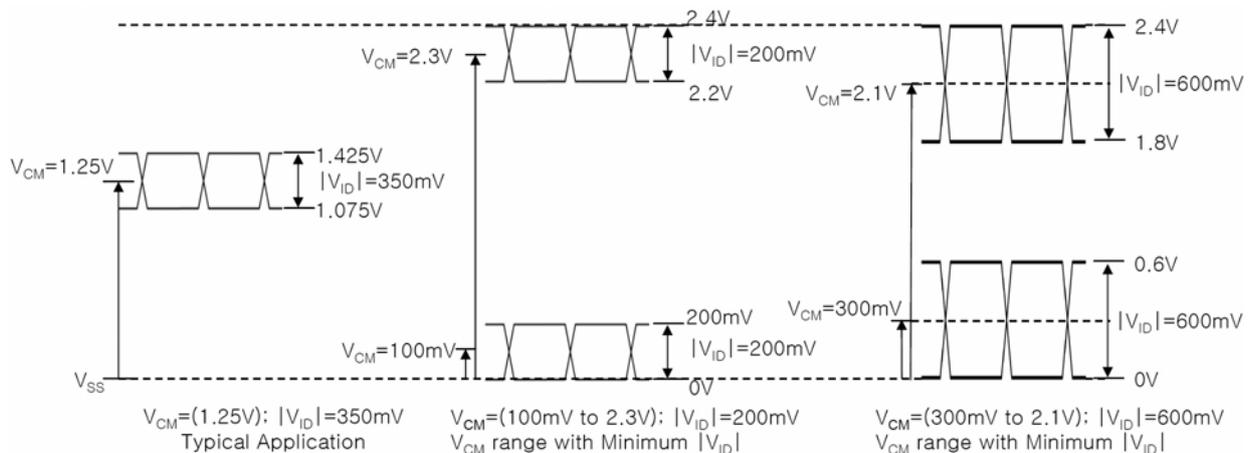
(5) fV=60Hz, fDCLK = 65MHz,   VDD = 3.3V, DC Current.

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

a) White Pattern

b) Mosaic Pattern
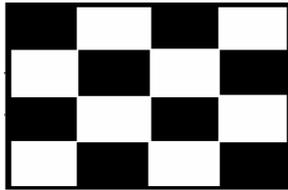
c) Dot Pattern
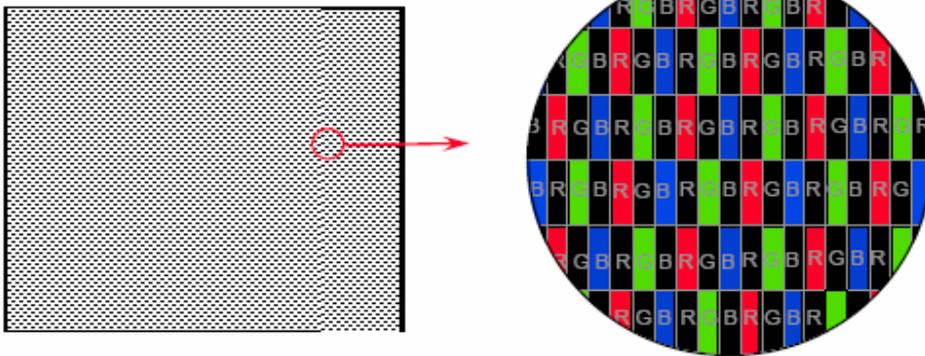
(7) Measurement Condition

100%
90%

10%
GND

V_{DD}

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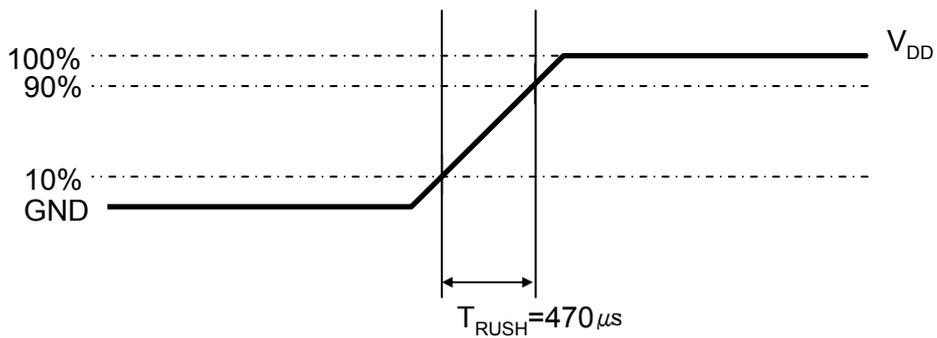
Rush Current I_{RUSH} can be measured when T_{RUSH}. is $470\mu s$.

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3.2 Back Light Unit

The back light unit is a direct type with 4 CCFTs (Cold Cathode Fluorescent Tube)
The characteristics of two dual lamps are shown in the following tables.

Ta=25 $\pm$ 2°C

Item		Symbol	Min.	Typ.	Max.	Unit	Note
Lamp Current		I$_L$	(3.0)	6.0	(6.5)	mArms	(1)
Lamp Voltage		V$_L$	-	(665)	-	Vrms	
Lamp Frequency		f$_L$	40	-	60	kHz	(3)
Operating Life Time		Hr	25,000	35,000	-	Hour	(4)
Inverter waveform	Asymmetry rate	Wasy	-	-	10	%	(5)
	Distortion rate	Wdis	1.2726	1.414	1.5554		
Startup Voltage		Vs	-	-	0℃ : (1,570)	Vrms	(6)
					25℃ : (1,120)		

Note (1) Specified values are for a single lamp.
Lamp current is measured with current meter for high frequency as shown below.
Refer to the following block diagram of the back light unit for more information.
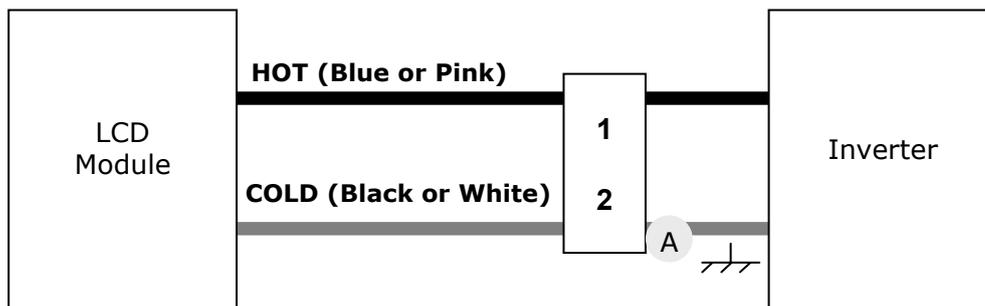
Fig. Measurement point of Lamp Current

(2) Define of Lamp current uniformity : I_{UNI}

$$I_{UNI} = \frac{|I_{Max} - I_{Min}|}{I_{Max}} \times 100$$

I_{max} : Maximum lamp current
I_{min} : Minimum lamp current

Lamp current uniformity I_{UNI} should be less than 25%

(3) Lamp frequency which may produce interference with horizontal synchronous frequency may cause line flow on the display. Therefore lamp frequency should be detached from the horizontal synchronous frequency and its harmonics as far as possible in order to avoid interference.

(4) Life time (Hr) is defined as the time when brightness of a lamp unit itself becomes 50% or less than its original value at the condition of Ta = 25$\pm$2°C and I_L = 7.5mArms

(5) Designing a system inverter intended to have better display performance, power efficiency and lamp reliability.
They would help increase the lamp lifetime and reduce leakage current.
a. The measurement should be done at typical lamp current.
b. The asymmetry rate of the inverter waveform should be less than 10%.
c. The distortion rate of the waveform should be $\sqrt{2}$ with $\pm$10% tolerance.
   - Inverter output waveform had better be more similar to ideal sine wave.

I_p

I_{-p}
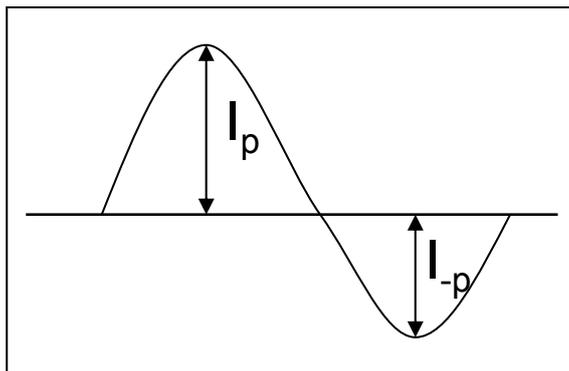
Fig. Wave form of the inverter

▪ Asymmetry rate

$$\frac{|I_p - I_{-p}|}{I_{rms}} \times 100$$

▪ Distortion rate

$$\left|\frac{I_p}{I_{rms}}\right| \quad \text{or} \quad \left|\frac{I_{-p}}{I_{rms}}\right|$$

(6) If an inverter has shutdown function, it should keep its output for over 1 second even if the lamp connector is open. Otherwise the lamps may not be turned on.

4. BLOCK DIAGRAM

4.1 TFT LCD Module
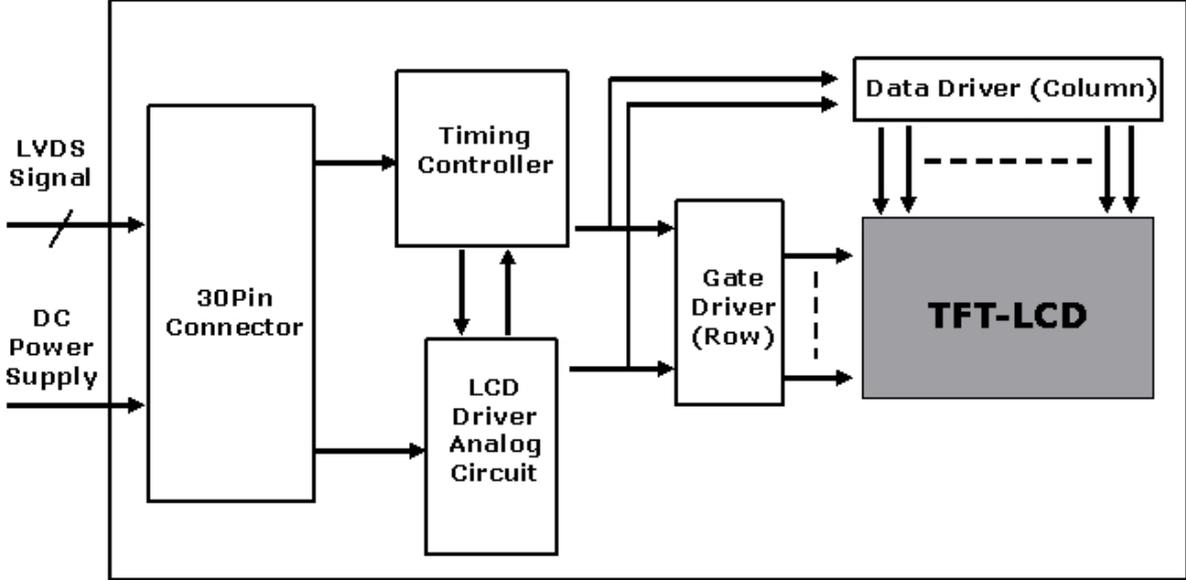
4.2 Back Light Unit
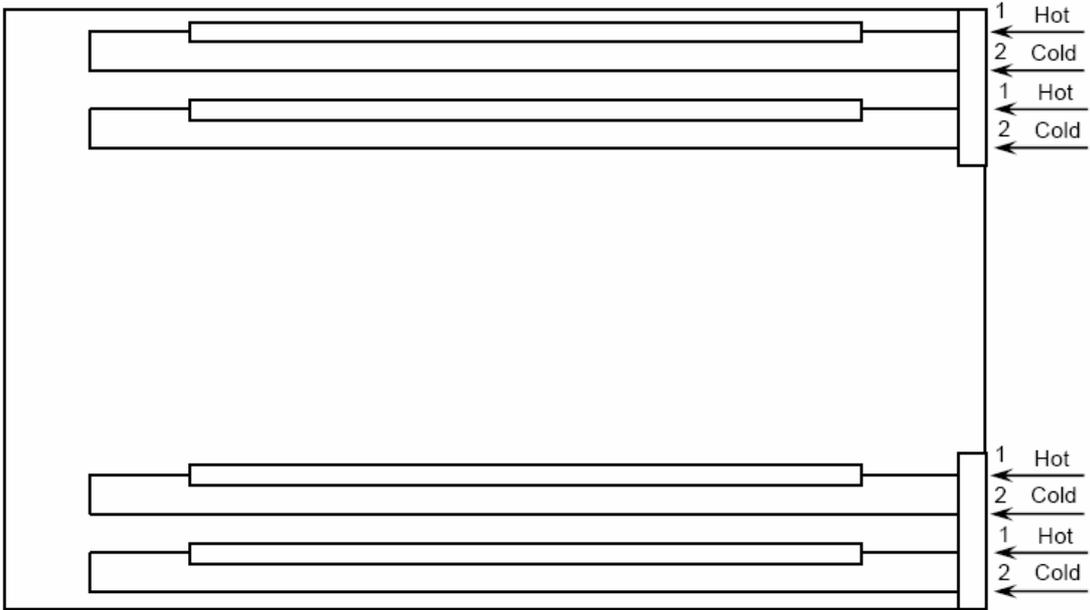
5. Input Terminal Pin Assignment

5.1 Input Signal & Power (Connector : Hirose DF14H-20P-1.25H)
Matching Socket : Hirose DF14-20S-1.25C

PIN NO	SYMBOL	FUNCTION	POLARITY	Output Pin# (LVDS Tx)	NOTE
1	VDD	Power Supply +3.3 V			
2	VDD	Power Supply +3.3 V			
3	GND	Power Ground			
4	GND	Power Ground			
5	RXIN0 -	LVDS Receiver Signal(-)	Negative	PIN#48	
6	RXIN0 +	LVDS Receiver Signal(+)	Positive	PIN#47	
7	GND	Ground	-		
8	RXIN1 -	LVDS Receiver Signal(-)	Negative	PIN#46	
9	RXIN1 +	LVDS Receiver Signal(+)	Positive	PIN#45	
10	GND	Ground	-		
11	RXIN2 -	LVDS Receiver Signal(-)	Negative	PIN#42	
12	RXIN2 +	LVDS Receiver Signal(+)	Positive	PIN#41	
13	GND	Ground	-		
14	RXCLK IN -	LVDS Receiver Clock Signal(-)	Negative	PIN#40	
15	RXCLK IN+	LVDS Receiver Clock Signal(+)	Positive	PIN#39	
16	GND	Ground	-		
17	RXIN3 -	LVDS Receiver Signal(-)	Negative	PIN#38	
18	RXIN3 +	LVDS Receiver Signal(+)	Positive	PIN#37	
19	GND	Ground	-		
20	NC	SEC's Internal use only	-		(1)

Note (1) If customer's system already uses the 20pin as GND, It should not exceed -200mV.

5.2 LVDS Interface

LVDS INTERFACE

DS90C385
THC63LVDM83A

DF14A-20P-1.25H

Host System 24-bit		
RED0	51	
RED1	52	TxOUT0−
RED2	54	
RED3	55	TxOUT0+
RED4	56	
RED5	3	
RED6	50	TxOUT1−
RED7	2	
GREEN0	4	TxOUT1+
GREEN1	6	
GREEN2	7	
GREEN3	11	TxOUT2−
GREEN4	12	
GREEN5	14	TxOUT2+
GREEN6	8	
GREEN7	10	
BLUE0	15	TxCLKOUT−
BLUE1	19	
BLUE2	20	TxCLKOUT+
BLUE3	22	
BLUE4	23	
BLUE5	24	TxOUT3−
BLUE6	16	
BLUE7	18	TxOUT3+
Hsync	27	
Vsync	28	
Enable	30	
CLOCK	31	

Connector signals:
- TxOUT0− 48 → 5 → 9 RxIN0−, 100Ω, 10 RxIN0+ (47 → 6)
- TxOUT0+ 47 → 6
- TxOUT1− 46 → 8 → 11 RxIN1−, 100Ω, 12 RxIN1+
- TxOUT1+ 45 → 9
- TxOUT2− 42 → 11 → 15 RxIN2−, 100Ω, 16 RxIN2+
- TxOUT2+ 41 → 12
- TxCLKOUT− 40 → 14 → 17 RxCLKIN−, 100Ω, 18 RxCLKIN+
- TxCLKOUT+ 39 → 15
- TxOUT3− 38 → 17 → 19 RxIN3−, 100Ω, 20 RxIN3+
- TxOUT3+ 37 → 18

Note : The LCD Module uses a 100ohm resistor between positive and negative lines of each receiver input.

5.3 BACK-LIGHT UNIT

Connector : JST BHSR - 02VS -1
Mating Connector : SM02B-BHSS-1(JST)

Pin NO.	Symbol	Color	Function
1	HOT	Pink or Blue	High Voltage
2	COLD	White or Black	Ground

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5.4 Input Signal,Basic Display Colors and Gray Scale of Each Colors

| Color	Display	Data Signal																								Gray Scale Level
		Red								Green								Blue								
		R0	R1	R2	R3	R4	R5	R6	R7	G0	G1	G2	G3	G4	G5	G6	G7	B0	B1	B2	B3	B4	B5	B6	B7	
Basic Color	Black	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	-
	Blue	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1	1	1	1	1	1	1	-
	Green	0	0	0	0	0	0	0	0	1	1	1	1	1	1	1	1	0	0	0	0	0	0	0	0	-
	Cyan	0	0	0	0	0	0	0	0	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	-
	Red	1	1	1	1	1	1	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	-
	Magenta	1	1	1	1	1	1	1	1	0	0	0	0	0	0	0	0	1	1	1	1	1	1	1	1	-
	Yellow	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	0	0	0	0	0	0	0	0	-
	White	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	-
Gray Scale of Red	Black	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	R000
	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	R001
		0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	R002
	↑	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	R003
		.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	~ 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	G000
	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	G001
		0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	G002
	↑	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	G003
		.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	~ 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	B000
	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	B001
		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	B002
	↑	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	B003
		.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	~ 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

5.5 Timing Diagrams of LVDS

LVDS Transmitter : National Semiconductor DS90C385MTD

Rx IN3	RxOUT23	RxOUT17	RxOUT16	RxOUT11	RxOUT10	RxOUT5	RxOUT27
	RESERVED	B07	B06	G07	G06	R07	R06
Rx IN2	RxOUT26	RxOUT25	RxOUT24	RxOUT22	RxOUT21	RxOUT20	RxOUT19
	DE	Vsync	Hsync	B05	B04	B03	B02
Rx IN1	RxOUT18	RxOUT15	RxOUT14	RxOUT13	RxOUT12	RxOUT9	RxOUT8
	B01	B00	G05	G04	G03	G02	G01
Rx IN0	RxOUT7	RxOUT6	RxOUT4	RxOUT3	RxOUT2	RxOUT1	RxOUT0
	G00	R05	R04	R03	R02	R01	R00

TxCLK OUT / RxCK IN — T, T/7

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5.6 PIXEL FORMAT

DATA1 DATA2   DATA1024

Line 1 | R | G | B | R | G | B | | R | G | B | R | G | B |

LTA150XH - L06 Panel

Line768 | R | G | B | R | G | B | | R | G | B | R | G | B |

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6. Interface Timing

6.1 Timing Parameters   (DE only mode)

SIGNAL	ITEM	SYMBOL	MIN.	TYP.	MAX.	Unit	NOTE
Clock	Frequency	$1/T_C$	47	65	80	MHz	-
Hsync		F_H	-	48.3	60.0	KHz	-
Vsync		F_V	-	60	75	Hz	-
Vertical Display Term	Active Display Period	T_{VD}	768	768	768	lines	-
Horizontal Display Term	Active Display Period	T_{HD}	1024	1024	1024	clocks	-
	Horizontal Total	T_H	1100	1344	1800	clocks	-

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

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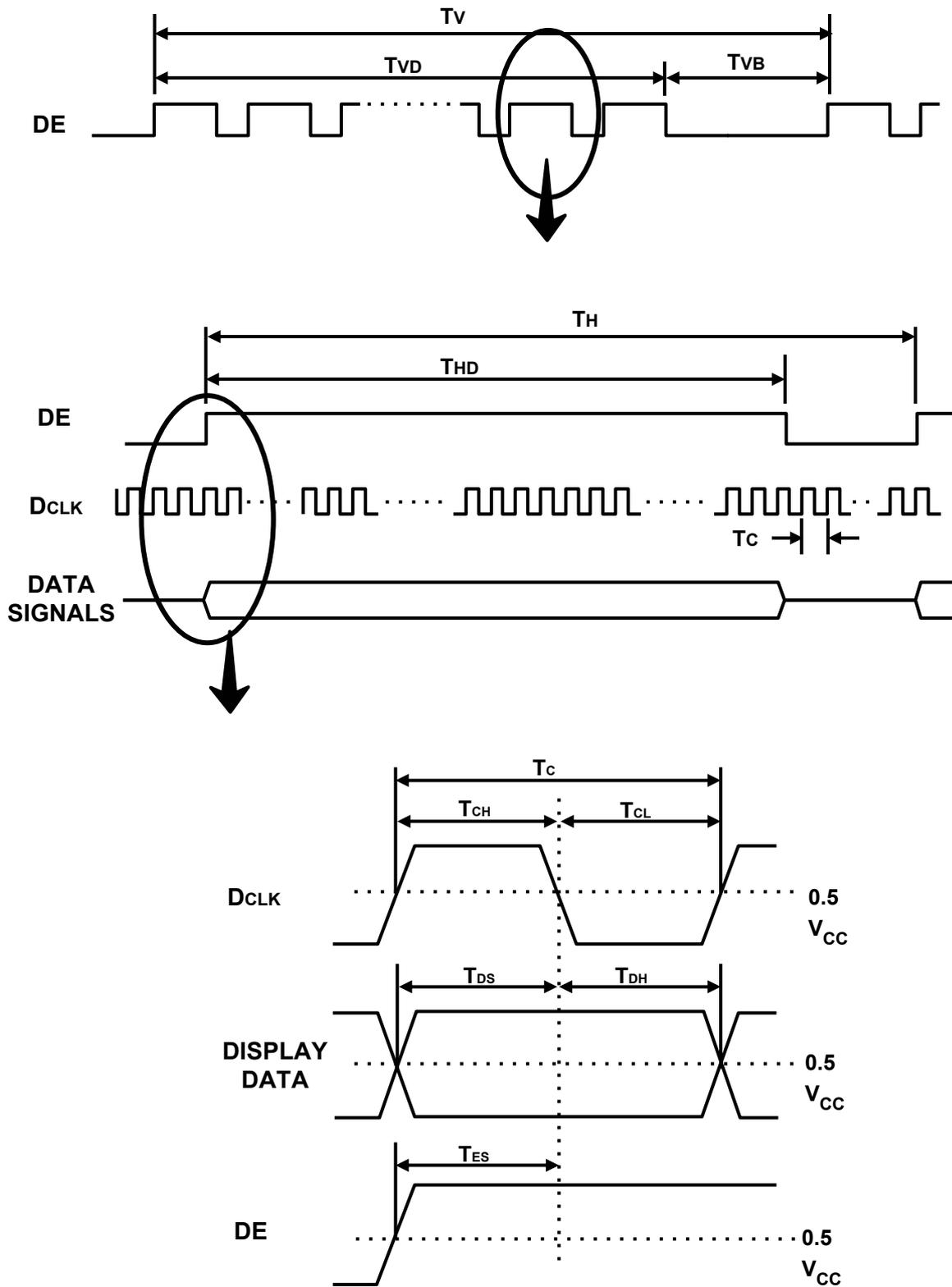
6.3 Power ON/OFF Sequence

   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 VDD
0.9 VDD
0.1 VDD
0V

$300\mu s \leq T1 \leq 10msec$
$0 \leq T2 \leq 50msec$
$0 \leq T3 \leq 50msec$
$1sec \leq T4$

T1
T2
T3
T4

Signals
0 V
VALID

Power On
Power Off

Back-Light (Recommended)
$500msec \leq T5$
$100msec \leq T6$

50%   50%

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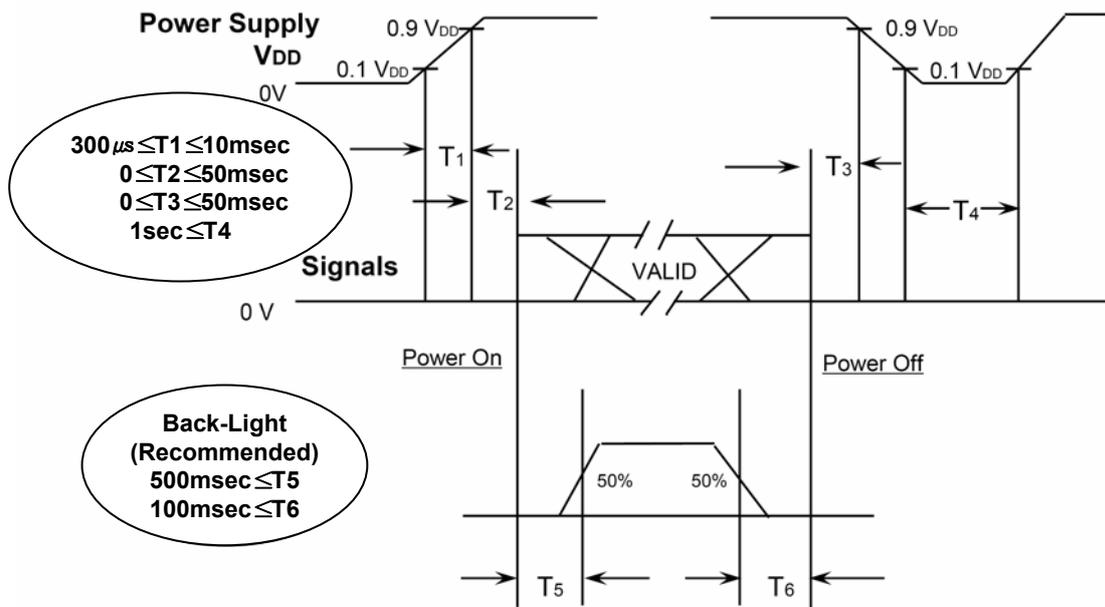
T1 : V_{DD} rising time from 10% to 90%
T2 : The time from V_{DD} to valid data at power ON.
T3 : The time from valid data off to V_{DD} off at power Off.
T4 : V_{DD} off time for Windows restart
T5 : The time from valid data to B/L enable at power ON.
T6 : The time from valid data off to B/L disable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

6.4 VDD Power Dip Condition
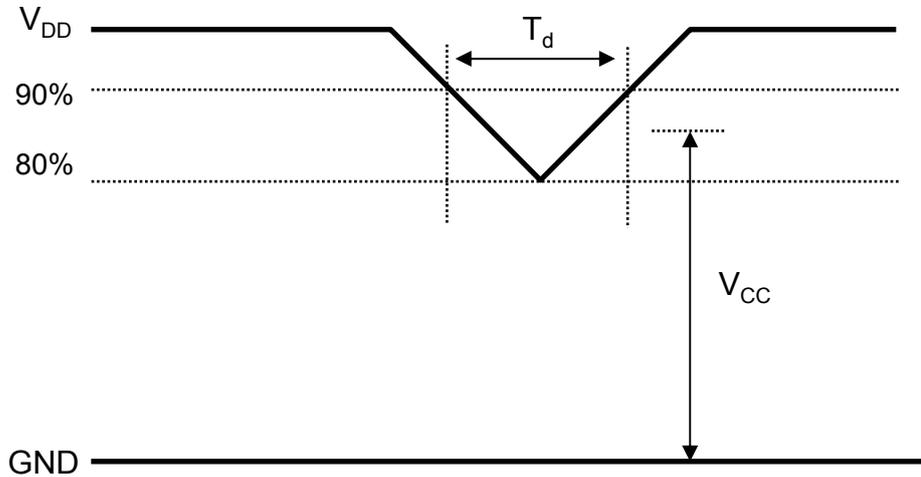
$$3.0V \leq V_{DD} \leq 3.6V$$
$$\text{If } V_{DD}(typ.) \times 80\% \leq V_{CC} \leq V_{DD}(typ) \times 90\%$$
$$\text{Then, } 0 < Td \leq 20msec$$

Note   (1) The above conditions are for the glitch of the input voltage.
(2) For stable operation of an LCD Module power, please follow them.
i.e., if typ VDD x 80% $\leq$ Vcc $\leq$ typ VDD x 90%, then T_d should be less than 20ms.

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7. General Precautions

7.1 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 uses high voltages, it should be disconnected from power source before it is assembled or disassembled.

(c) Refrain from strong mechanical shock and / or any force to the module. In addition to damage, it may cause improper operation or damage to the module and CCFT back light.

(d) Note that polarizer films are very fragile and could be damaged 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 cause 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.

7.2 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.

7.3 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 item 6.3
"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).

7.4 Operation Condition Guide

(a) The LCD product should be operated under normal conditions.
Normal condition is defined as below;
- Temperature : 20±15℃
- Humidity : 65±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.

7.5 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.

FILE NO.

PCB COVER

307.2 ±0.5 (BEZEL OPENING)
304.128 (ACTIVE AREA)
2-120 ±5
CN2

3 ±0.5

12.5 ±0.5
6 ±0.5
3 ±0.5

52.55 ±1.0

73.71 ±1.0

CN1

2-Ø3.2 (HOLE)

6 ±0.3

127.41
106 ±0.5
254.76 ±0.5

95 ±0.5
100 ±0.5

231.1 ±0.5 (BEZEL OPENING)
228.096 (ACTIVE AREA)

ACTIVE CENTER

95 ±0.5
100 ±0.5

127.35
106 ±0.5

2-R1.6

CN2

LTM150XH(L5)

NOTE 6

163.8 ±0.5   163.3 ±0.5
165.8 ±0.5   165.8 ±0.5
331.6 ±0.5

wise view ™

SAMSUNG TFT-LCD

MADE IN KOREA

NOTE 7
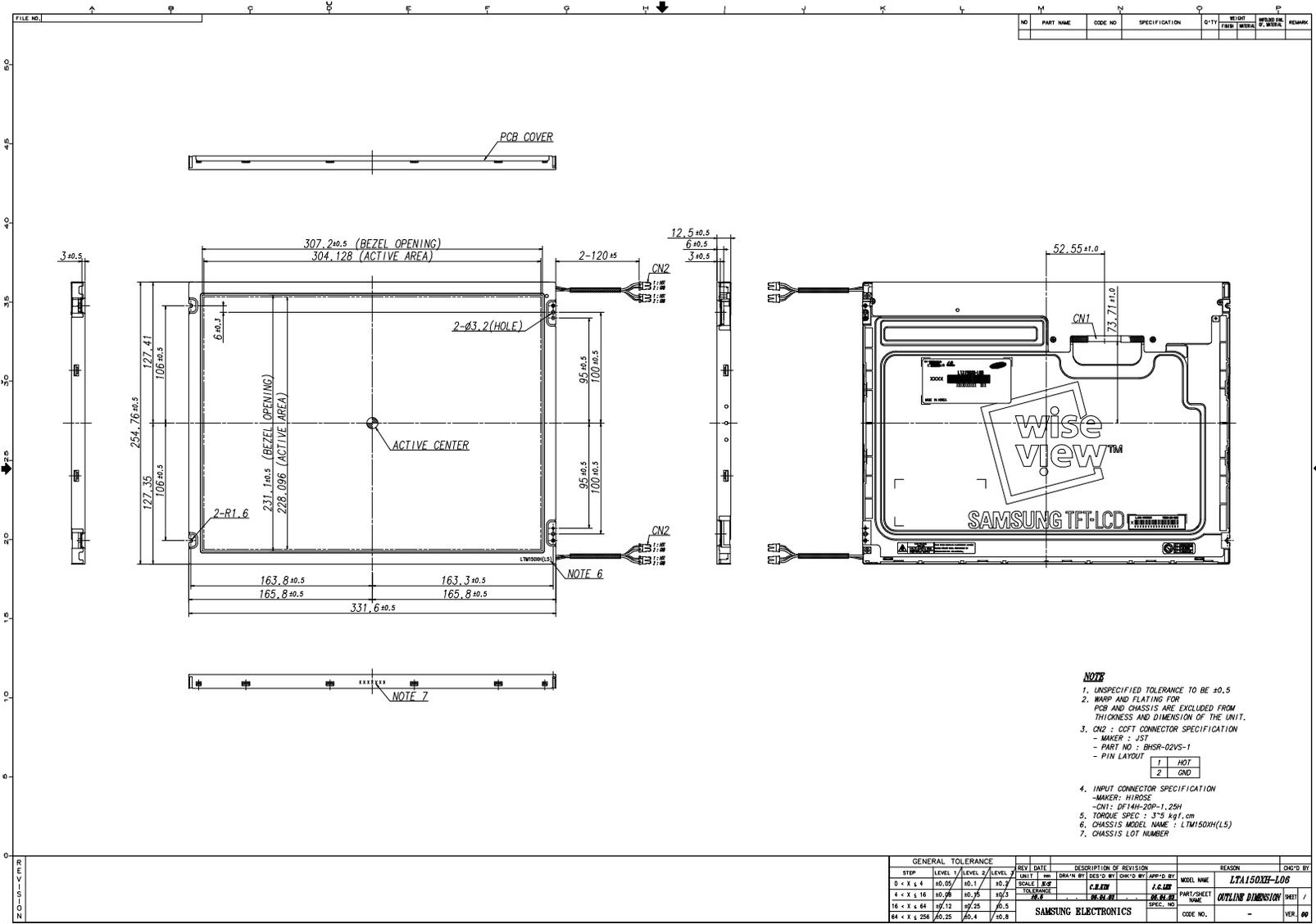
NOTE
1. UNSPECIFIED TOLERANCE TO BE ±0.5
2. WARP AND FLATING FOR
   PCB AND CHASSIS ARE EXCLUDED FROM
   THICKNESS AND DIMENSION OF THE UNIT.
3. CN2 : CCFT CONNECTOR SPECIFICATION
   - MAKER : JST
   - PART NO : BHSR-02VS-1
   - PIN LAYOUT

| 1 | HOT |
| 2 | GND |

4. INPUT CONNECTOR SPECIFICATION
   -MAKER: HIROSE
   -CN1: DF14H-20P-1.25H
5. TORQUE SPEC : 3~5 kgf.cm
6. CHASSIS MODEL NAME : LTM150XH(L5)
7. CHASSIS LOT NUMBER