Product Information

ISSUE DATE : Aug. 10, 2001
MODEL : LTM150XH-L06

NOTE : This product information is subject to change after 3 months of issuing date.

SAMSUNG ELECTRONICS CO., LTD.

Better Vision through SAMSUNG TFT-LCD

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GENERAL DESCRIPTION

DESCRIPTION

LTM150XH-L06 is a color active matrix TFT (Thin Film Transistor) liquid crystal display that uses amorphous silicon TFT switching devices. This model is composed of a TFT LCD panel, a driver circuit and a back-light system. The resolution of 15.0- inch contains 1,024 x 768 pixels and can display up to 16.2M colors. 6 o'clock direction is the optimum viewing angle.

FEATURES

- High contrast ratio, High aperture structure
- Wide viewing angle
- High-speed response
- XGA(1024x768 pixels) resolution
- 8-bit color depth, Display 16.2M colors
- Low power consumption
- 4 CCFTs (Cold Cathode Fluorescent Tube)
- DE Only Mode
- LVDS Interface with 1pixels / clock

APPLICATIONS

- TV&Desktop monitors
- Display terminals for AV application products
- Monitors for Industrial machine

GENERAL SPECIFICATIONS

ITEM	SPECIFICATION	UNIT	NOTE
Active area	304.1(H) x228.1(V) (15.0 inch diagonal)	mm	
Driver element	a-Si TFT active matrix		
Display colors	16,194,277		
Number of pixel	1024 x 768	pixel	
Pixel arrangement	RGB vertical stripe		
Pixel pitch	0.297(H) x 0.297(W)	mm	
Display Mode	Normally white		
Surface treatment	Haze 25 , Anti-glare & Hard - Coating (3H)		

Mechanical Information

ITEM		MIN.	TYP.	MAX.	NOTE
Module size	Horizontal (H)	331.1	331.6	332.1	mm
	Vertical (V)	254.4	254.9	255.4	mm
	Depth (D)	-	12.5	13.0	mm
Weight		-	-	1350	g

1. ELECTRICAL ABSOLUTE RATINGS

1.1 TFT LCD MODULE

(Vss =GND= 0 V)

ITEM	SYMBOL	MIN.	MAX.	UNIT	NOTE
Power Supply Voltage	V_{DD}	Vss-0.3	4.0	V	(1)

NOTE (1) Within Ta (25 ± 2 °C)

1.2 BACK-LIGHT UNIT

Ta = 25 ± 2 °C

ITEM	SYMBOL	MIN.	MAX.	UNIT.	NOTE
Lamp current	I_L	3.0	6.5	mA_{rms}	(1)
Lamp frequency	f_L	40	80	kHz	(1)

NOTE (1) Permanent damage to the device may occur if maximum values are exceeded.
Functional operation should be restricted to the conditions described under Normal Operating Conditions.

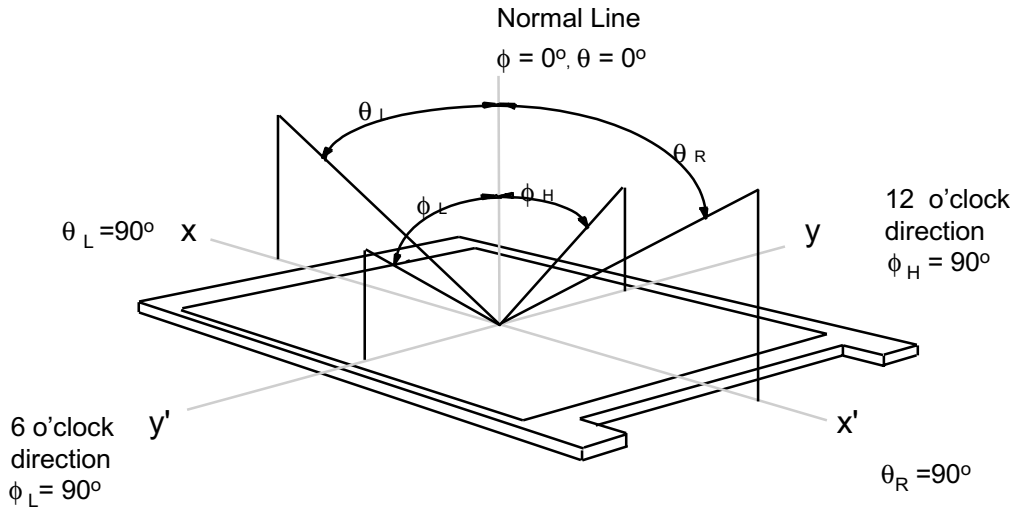
2. OPTICAL CHARACTERISTICS

The following items are measured under stable conditions. The optical characteristics should be measured in a dark room or equivalent state with the methods shown in Note (4).
Measuring equipment : TOPCON BM-5A

* Ta = 25 ± 2 °C , V_{DD} = 3.3V, fv= 60Hz, f_{DCLK}=65MHz, I_L = 6.5 mArms

ITEM		SYMBOL	CONDITION	MIN	TYP	MAX	UNIT	NOTE
Contrast Ratio		CR		200	300	-		(1),(2),(4)
Response Time at Ta	Rising	T_R		-	5	-	msec	(1), (3)
	Falling	T_F		-	20	-		
Luminance of White (Center Point)		Y_L		400	450	-	cd/m^2	(1),(4) At 6.5mA
Color Chromaticity (CIE 1931)	Red	R_X	ϕ = 0, θ = 0 Normal Viewing Angle	0.603	0.628	0.653		(1), (4)
		R_Y		0.328	0.353	0.378		
	Green	G_X		0.265	0.290	0.315		
		G_Y		0.570	0.595	0.620		
	Blue	B_X		0.119	0.144	0.169		
		B_Y		0.063	0.088	0.113		
	White	W_X		0.279	0.304	0.329		
		W_Y		0.300	0.325	0.350		
Viewing Angle	Hor.	θ_L	CR ≥ 10	65	70	-	Degrees	
		θ_R		65	70	-		
	Ver.	ϕ_H		50	60	-		
		ϕ_L		60	65	-		
Brightness Uniformity		B_{UNI}		-	-	25	%	(5)

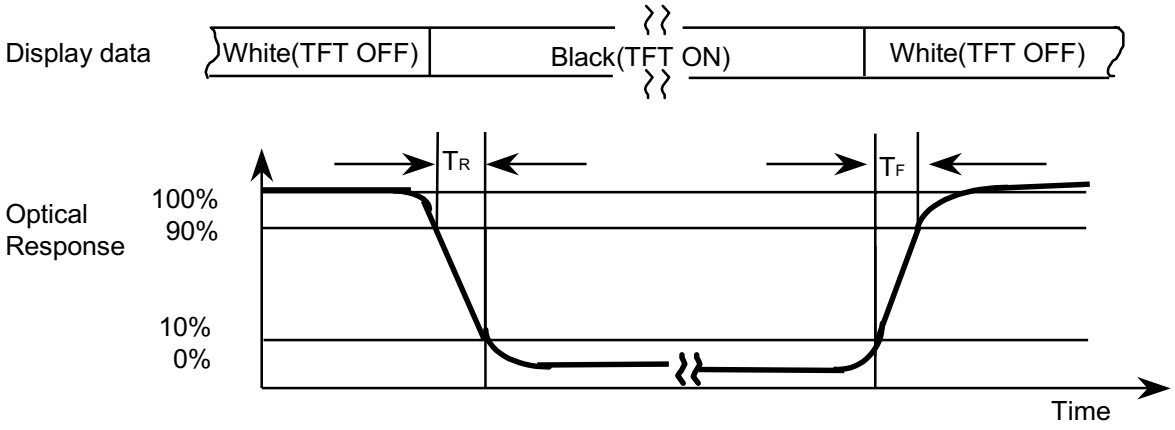
Note 1) Definition of Viewing Angle : Viewing angle range (10 ≤ CR)



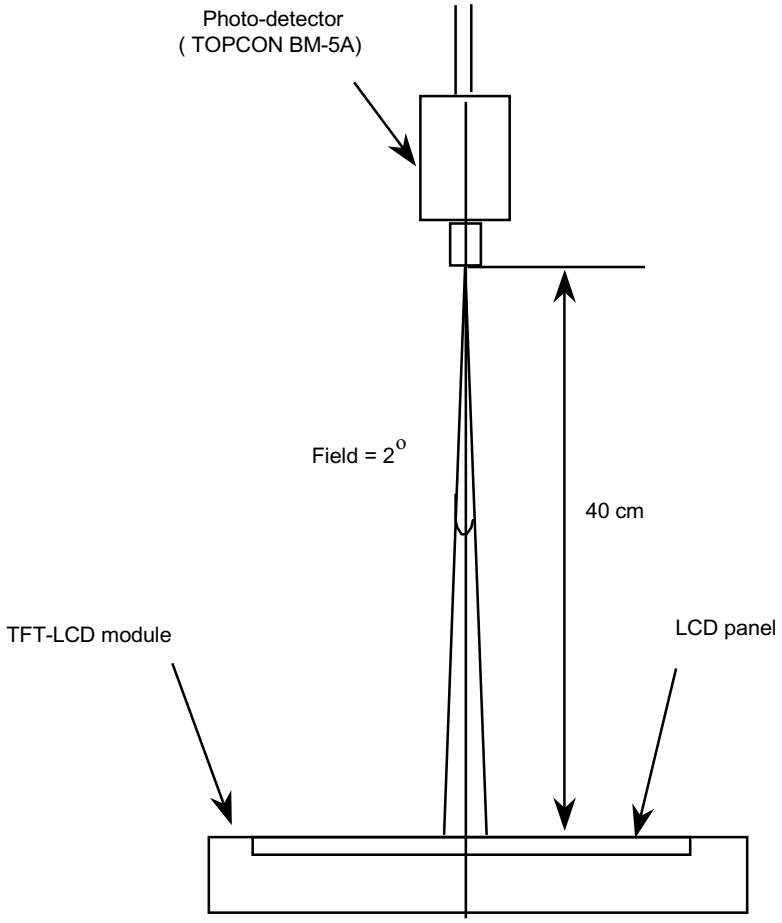
Note 2) Definition of Contrast Ratio (CR) : Ratio of gray max (Gmax) ,gray min (Gmin) at the center point of panel.

$$CR = \frac{\text{Luminance with all pixels white (Gmax)}}{\text{Luminance with all pixels black (Gmin)}}$$

Note 3) Definition of Response time :



Note 4) After stabilizing and leaving the panel alone at a given temperature for 30 min , the measurement should be executed. Measurement should be executed in a stable, windless, and dark room. 30 min after lighting the back-light. This should be measured in the center of screen.
lamp current : 6.5mA
Environment condition : Ta = 25 ± 2 °C



Optical characteristics measurement setup

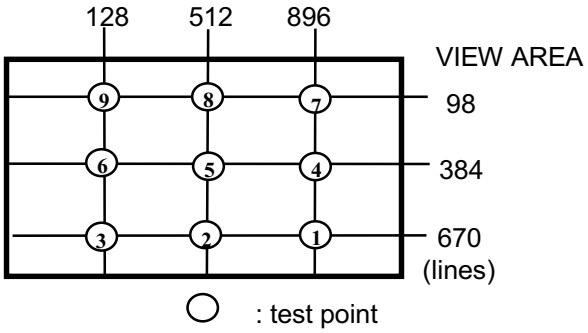
Note 5) Definition of 9 points brightness uniformity

$$B_{UNI} = \frac{\left| \text{Bmax or Bmin - Bave} \right|}{\text{Bave}} \text{ X 100}$$

Bmax : Maximum Brightness

Bmin : Minimum Brightness

Bave : Average Brightness = $\frac{\sum_{k=1}^{9} (B(k))}{9}$



3. ELECTRICAL CHARACTERISTICS

3.1 TFT LCD MODULE

Ta= 25 ± 2 ˚C

ITEM		SYMBOL	MIN	TYP	MAX	UNIT	NOTE
Voltage of Power Supply		V_{DD}	3.0	3.3	3.6	V	
Differential Input Threshold Voltage	High	V_{IH}	-	-	+ 100	mV	(1)
	Low	V_{IL}	- 100	-	-	mV	
Current of Power Supply	White	I_{DD}	-	380	-	mA	(2)(4)*a
	Mosaic		-	420	-	mA	(2)(4)*b
	Sub-pixel checker		-	470	550	mA	(2)(4)*c
Vsync Frequency		fV	-	60	-	Hz	
Hsync Frequency		fH	-	48.4	-	kHz	
Main Frequency		fDCLK	-	65	-	MHz	(3)
Rush Current		Irush	-	-	1.5	A	(5)

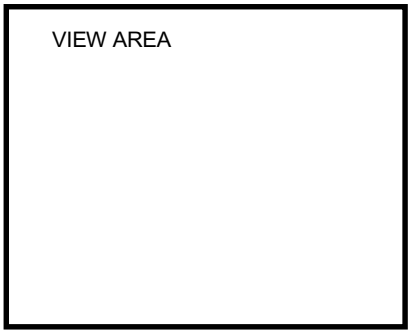
Note (1) Condition : VCM = +1.2V (Typical)

(2) f_V=60Hz, f_{DCLK} =65MHZ, V_{DD} = 3.3V, DC Current.

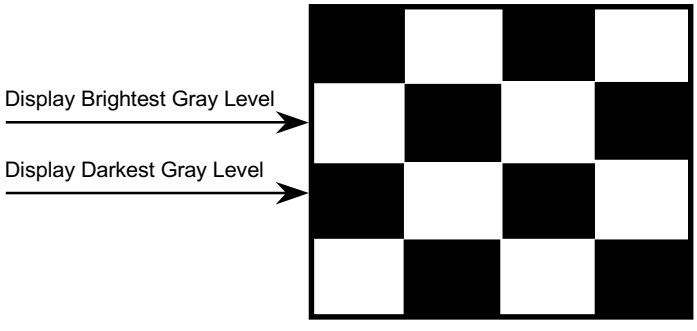
(3) 1 Pixels/clock

(4) Power dissipation check pattern

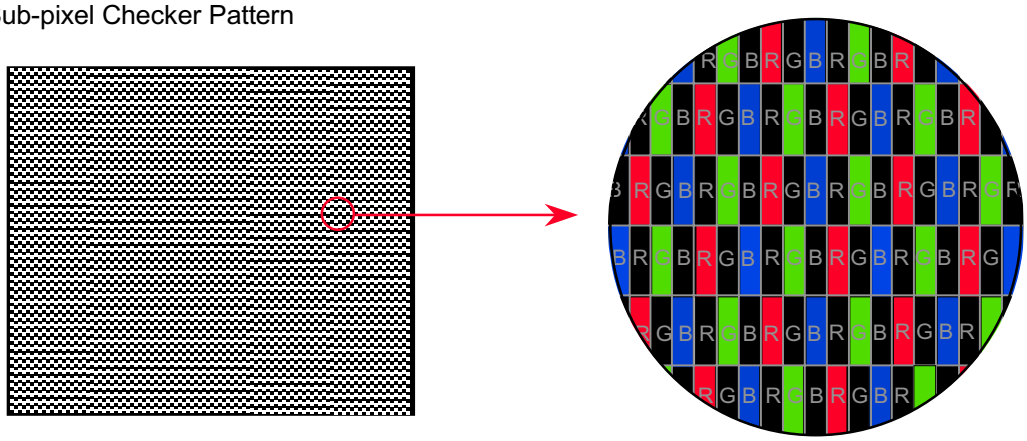
*a) White Pattern



*b) Mosaic Pattern

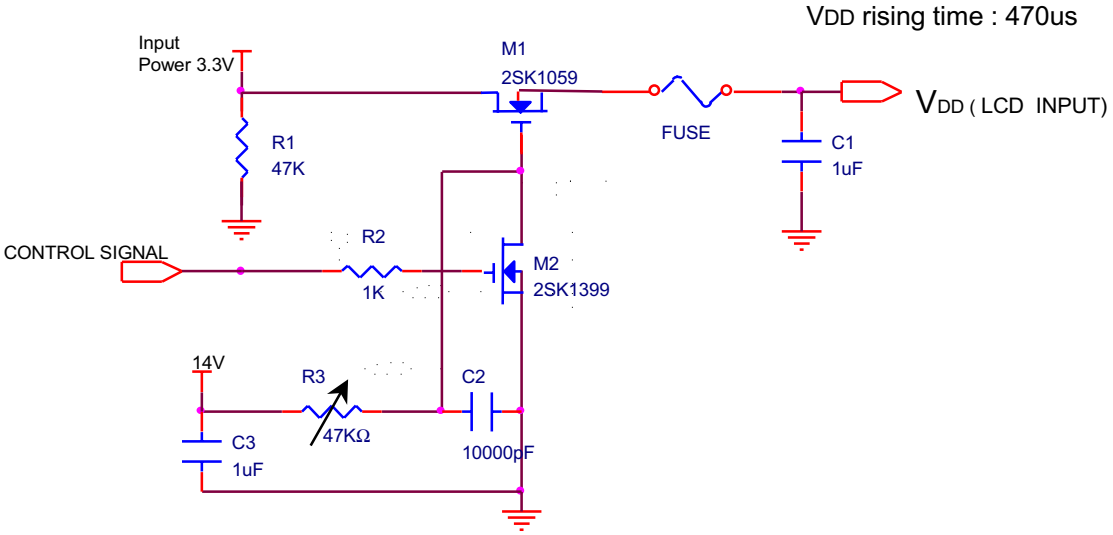


c) Sub-pixel Checker Pattern



(4) Measurement Conditions

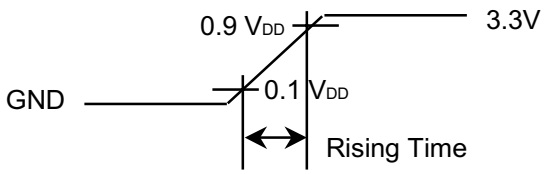
VDD rising time : 470us



Note : Control Signal : High(+3.3V) -->Low(Ground)

All Signal lines to panel except for power 3.3V : Ground

The rising time of supplied voltage is controlled to 470us by R3 and C2 value.



3.2 BACK-LIGHT UNIT

The back-light system is an edge - lighting type with 4 CCFTs (Cold Cathode Fluorescent Tube).
The characteristics of two lamps are shown in the following tables.

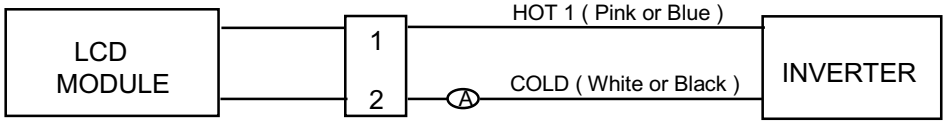
Ta= 25 ± 2 °C

ITEM	SYMBOL	MIN	TYP	MAX	UNIT	NOTE
Lamp Current	I_L	3.0	6.0	6.5	mA_{rms}	(1)
Lamp Voltage	V_L	-	665	-	V_{rms}	I_L=6.0 mArms
Frequency	f_L	40	-	60	KHz	(2)
Operating Life Time	Hr	25,000	-	-	Hour	(3)
Startup Voltage	Vs	-	-	1020 (25°C) 1430 (0°C)	V_{rms}	(4)

Note) The waveform of the inverter output voltage must be area symmetric and the design of the inverter must have specifications for the modularized lamp.

The performance of the back-light, for example life time or brightness, is much influenced by the characteristics of the DC-AC inverter for the lamp. So all the parameters of an inverter should be carefully designed so as not to produce too much leakage current from high-voltage output of the inverter.
When you design or order the inverter, please make sure that a poor lighting caused by the mismatch of the back-light and the inverter(miss lighting, flicker, etc.) never occur. When you confirm it, the module should be operated in the same condition as it is installed in your instrument.

Note (1) Lamp current is measured with current meter for high frequency as shown below.



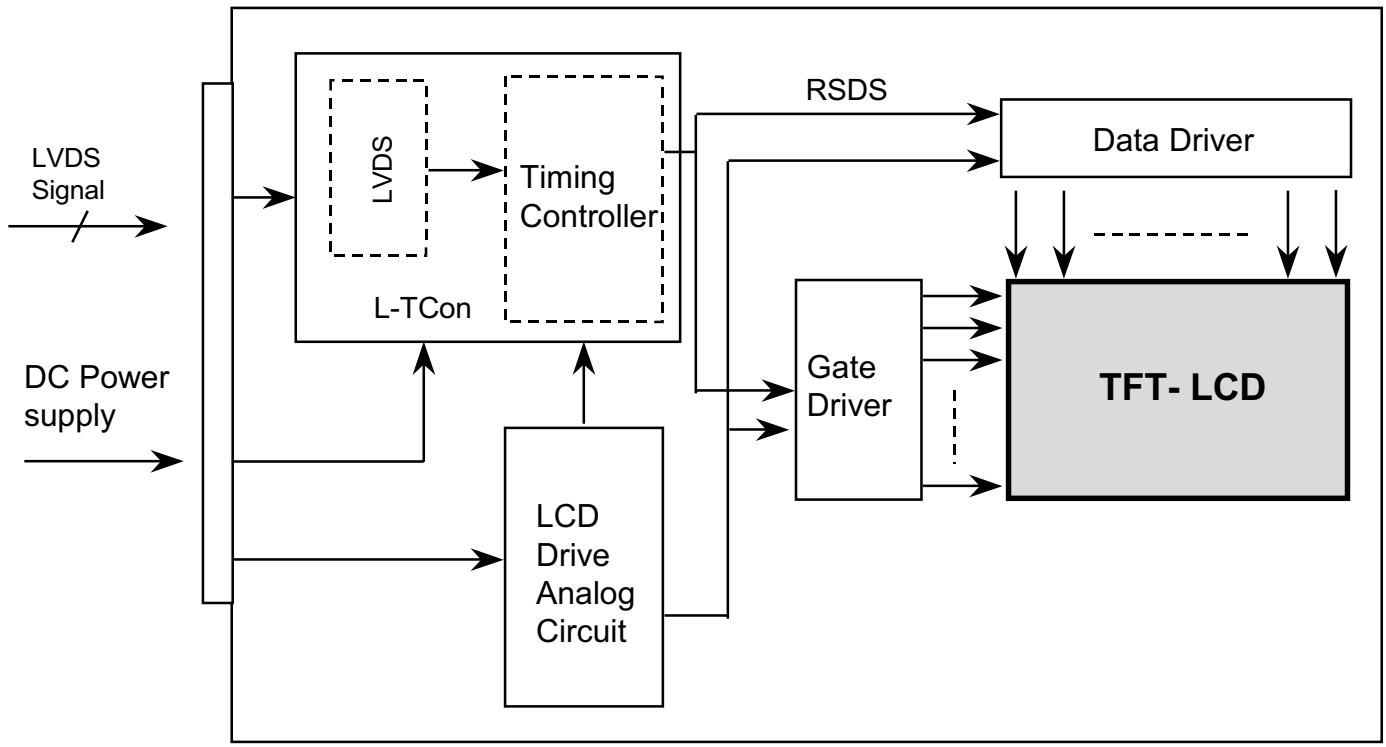
(2) Lamp frequency may produce interference with horizontal synchronous frequency and this may cause line flow on the display. Therefore lamp frequency shall be detached from the horizontal synchronous frequency and its harmonics as far as possible in order to avoid interference.

(3) Life time (Hr) of a lamp is defined as the time in which it continues to operate under the condition of Ta = 25 ± 2 °C and I_L = 6.0 mArms until the brightness becomes 50% or lower than it's original value.

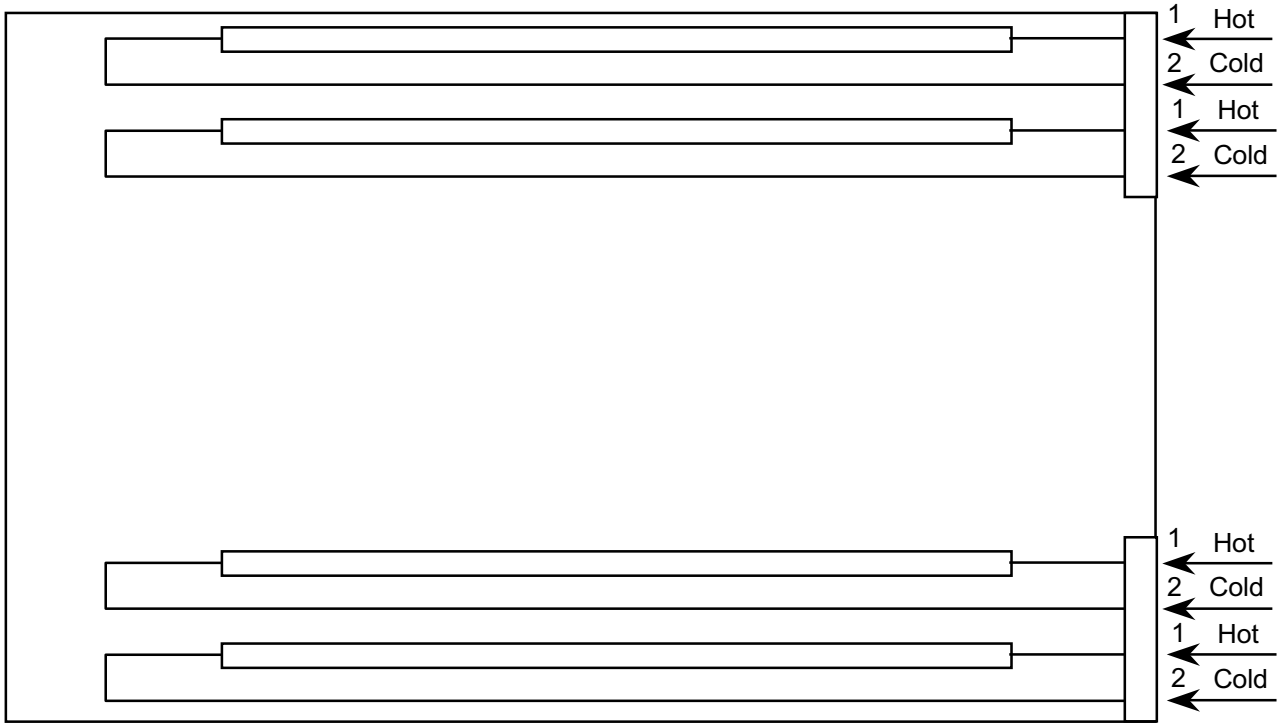
(4) The voltage above this value should be applied to the lamps for more than 1 second to startup. Otherwise the lamps may not to be turned on.

4. BLOCK DIAGRAM

4.1 TFT LCD MODULE



4.2 BACK-LIGHT UNIT



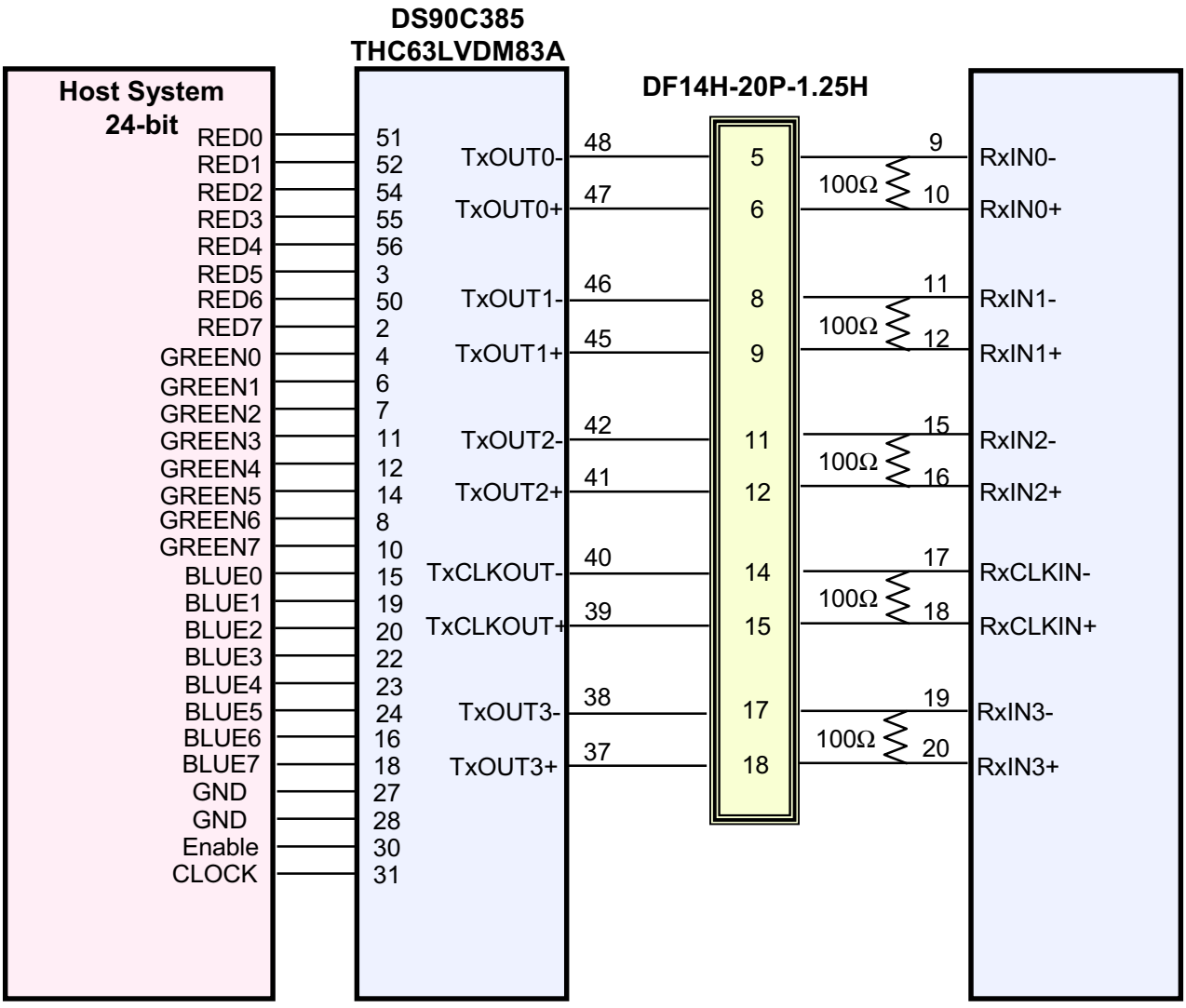
5. INPUT TERMINAL PIN ASSIGNMENT

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

PIN NO	SYMBOL	FUNCTION	POLARITY	Output Pin# (LVDS Tx)
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	Reserved	-	

5.2 LVDS Interface

LVDS INTERFACE



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

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

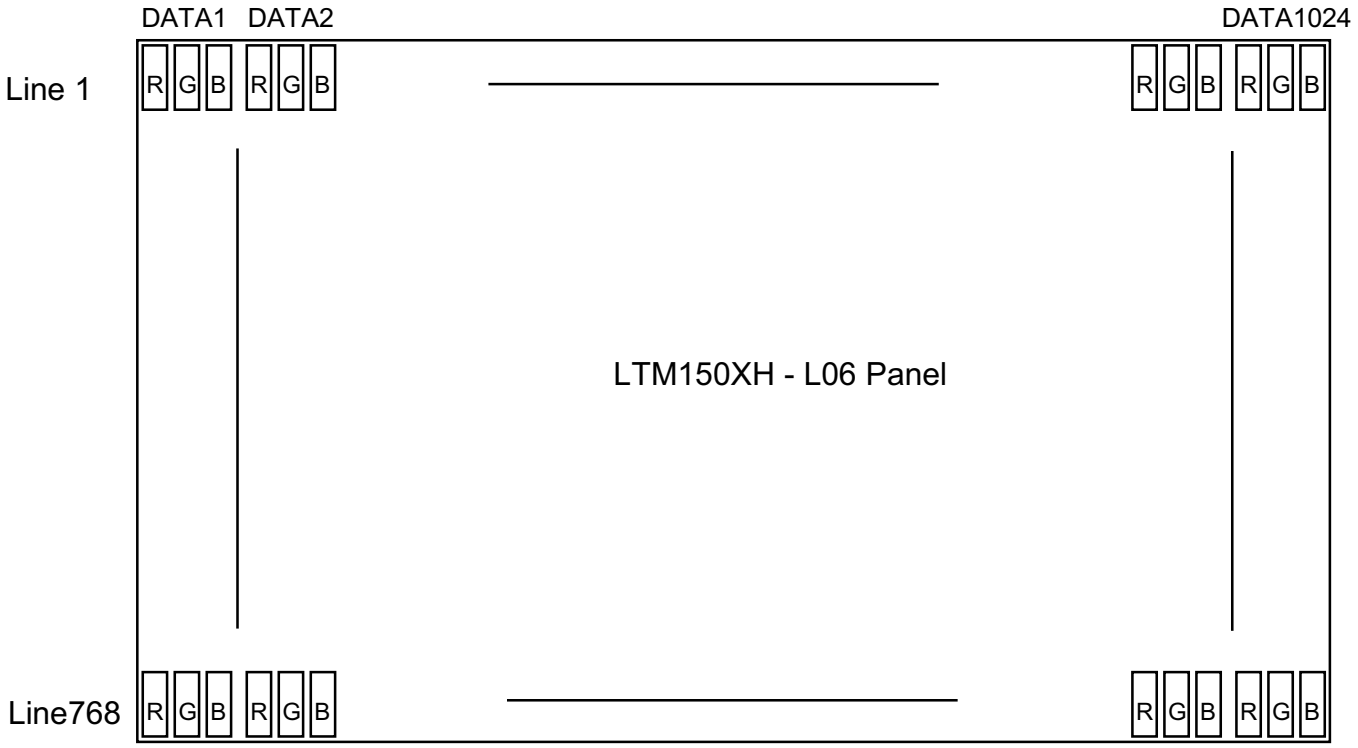
Color	Display	Data Signal																								Gray Scale Level
		Red								Green								Blue								
		R0	R1	R2	R3	R4	R5	R6	R7	G0	G1	G2	G3	G4	G5	G6	G7	B0	B1	B2	B3	B4	B5	B6	B7	
Basic Color	Black	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	-
	Blue	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1	1	1	1	1	1	1	-
	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 PIXEL FORMAT



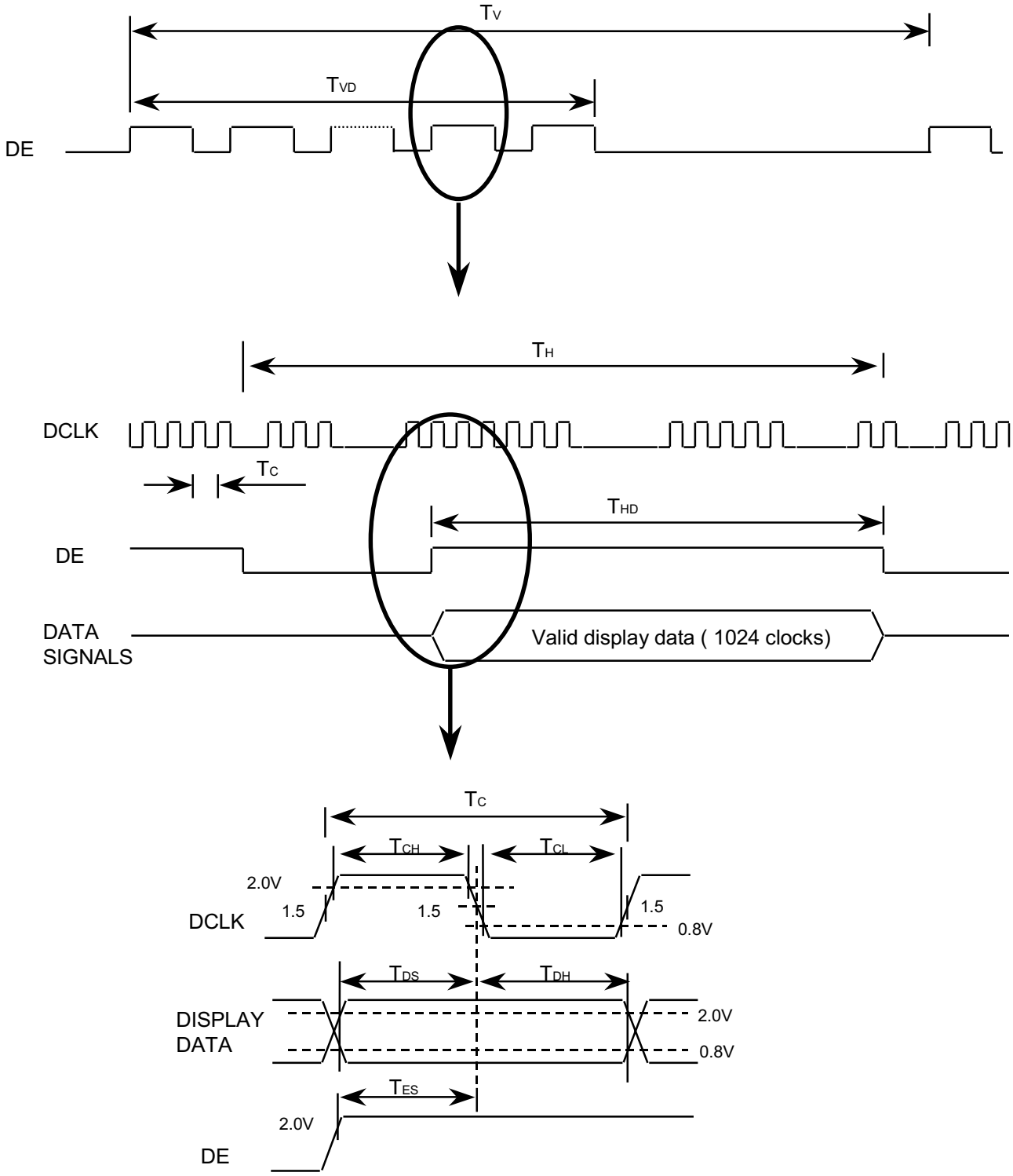
6. INTERFACE TIMING

6.1 Timing Parameters (DE only mode, LVDS Transmitter Input)

Signal	Item	Symbol	MIN	TYP	MAX	Unit	Note
Clock	Frequency	1 / TC	-	65	80	MHz	
	High Time	TCH	4.5	-	-	nsec	
	Low Time	TCL	4.5	-	-	nsec	
Data	Setup Time	TDS	2.7	-	-	nsec	
	Hold Time	TDH	0	-	-	nsec	
Data Enable	Setup Time	TES	2.7	-	-	nsec	(1)
Frame Frequency	Cycle	TV	772	16.7 | 806	-	msec | lines	
Vertical Active Display Term	Display Period	TVD	768	768	768	lines	
One Line Scanning Time	Cycle	TH	1100	1344	1800	clocks	
Horizontal Active Display Term	Display Period	THD	1024	1024	1024	clocks	

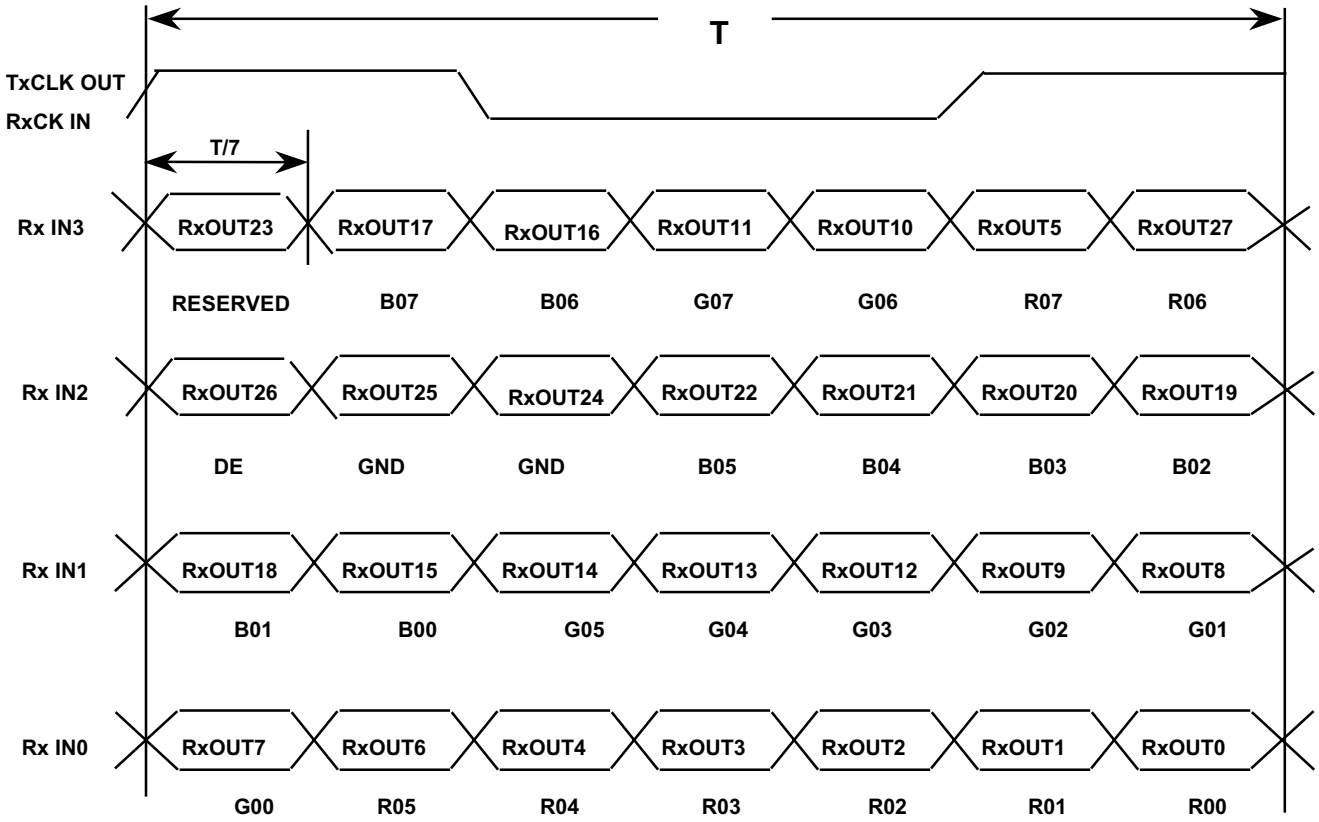
Note (1) When LTM150XH-L06 model is operated by DE only mode, Hsync and Vsync input signals should be fixed to "Low" for stable operation. Otherwise, the module could operate abnormally.

6.2 Timing diagrams of interface signal (DE mode)



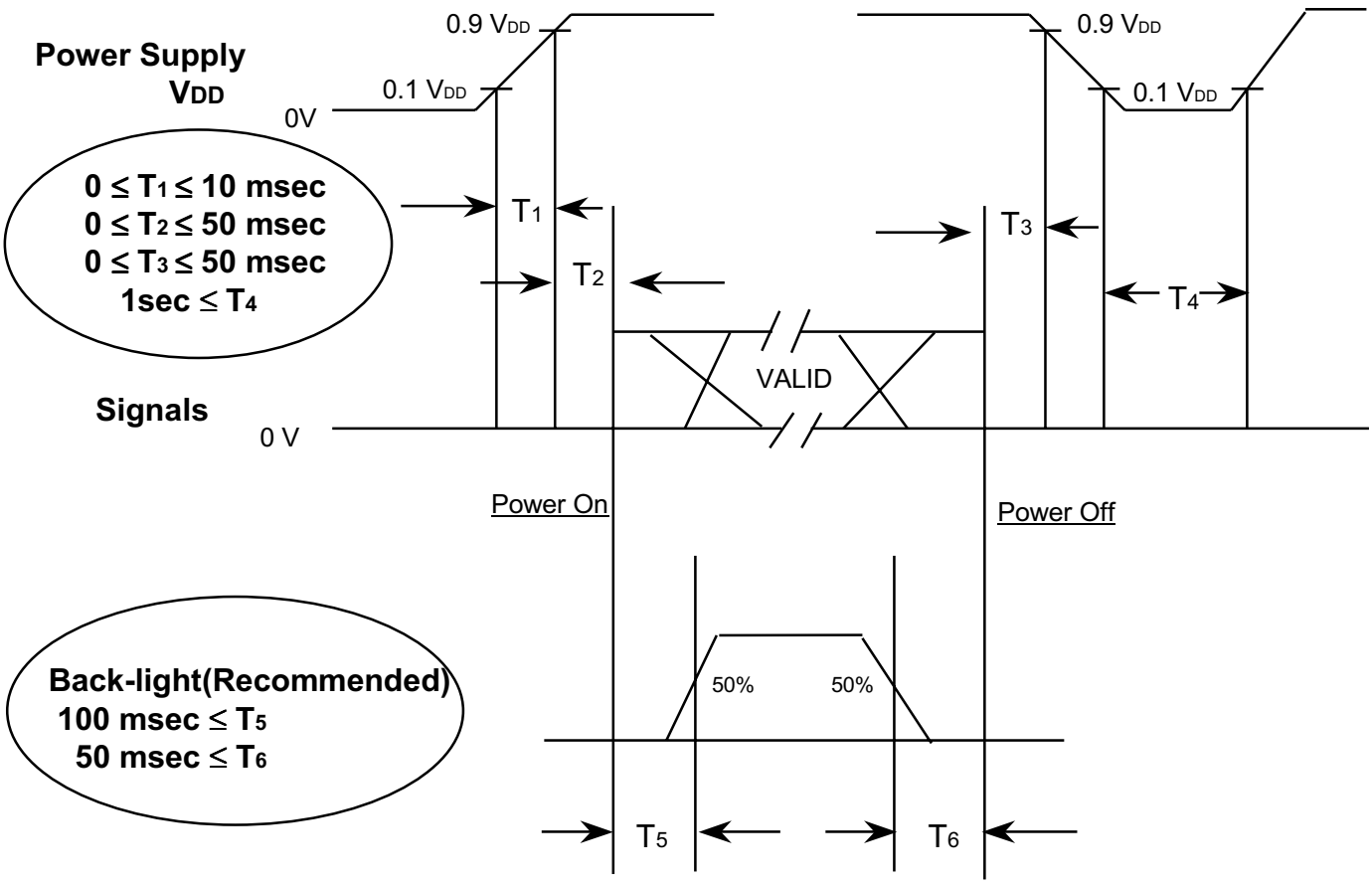
6.3 Timing Diagrams of LVDS

LVDS Transmitter : National Semiconductor DS90C385MTD



6.4 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 ON/OFF Sequence

NOTE.

(1) The supply voltage of the external system for the module input should be the same as the definition of V_{DD}.

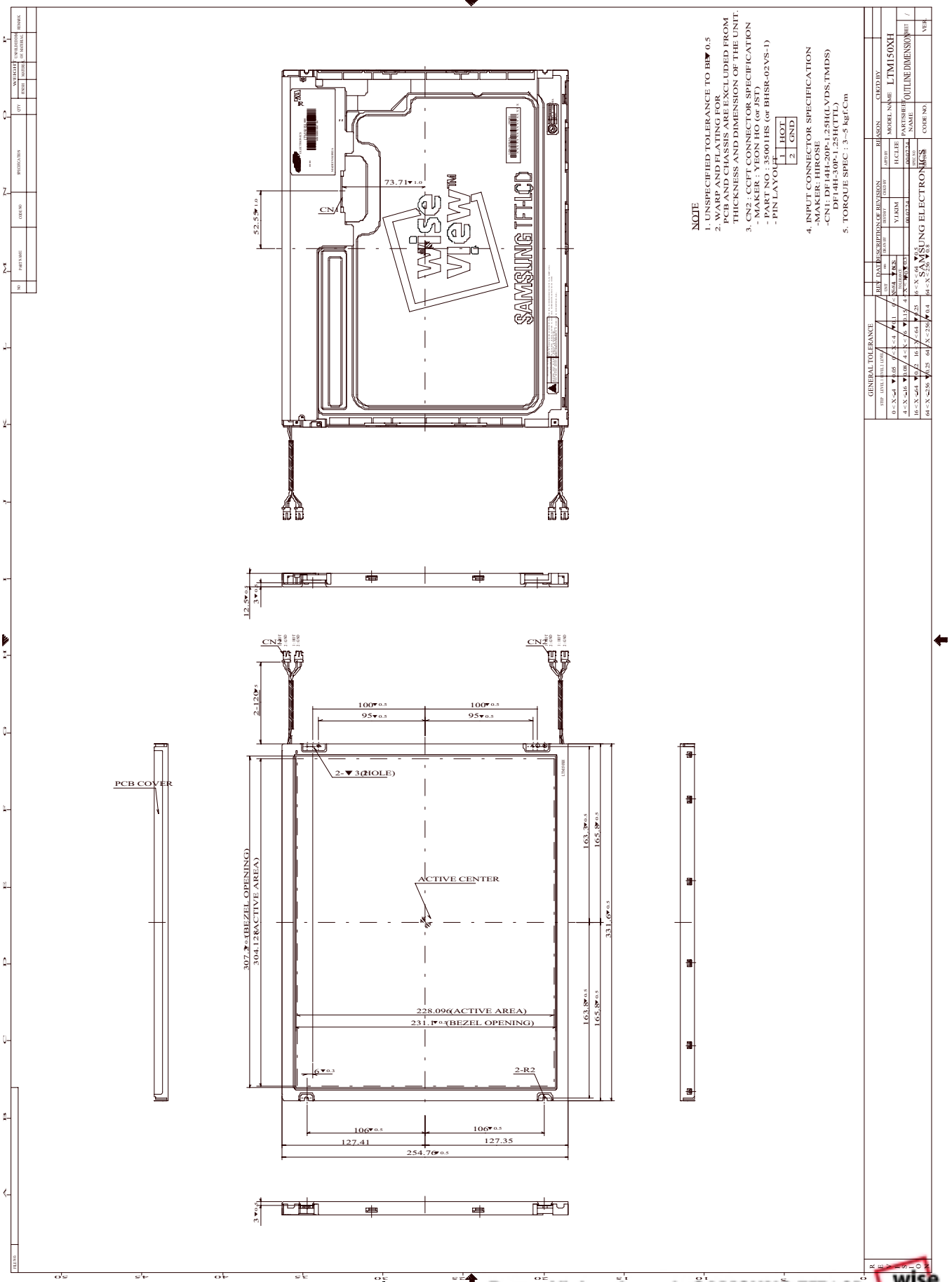
(2) Apply the lamp voltage within the LCD operation range. When the back-light turns on before the LCD operation or the LCD turns off before the back-light turns off, the display may momentarily become white.

(3) In case of V_{DD} = off level, please keep the level of input signals on the low or keep a high impedance.

(4) T4 should be measured after the module has been fully discharged between power off and on period.

(5) Interface signal shall not be kept at high impedance when the power is on.

7. OUTLINE DIMENSION



8. GENERAL PRECAUTIONS

8.1 Handling

(a) When the module is assembled, It should be attached to the system firmly using every mounting holes. Be careful not to twist and bend the modules.

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

(c) Note that polarizers are very fragile and could be easily damaged. Do not press or scratch the surface harder than a HB pencil lead.

(d) Wipe off water droplets or oil immediately. If you leave the droplets for a long time, Staining and discoloration may occur.

(e) If the surface of the polarizer is dirty, clean it using some absorbent cotton or soft cloth.

(f) The desirable cleaners are water, IPA(Isopropyl Alcohol) or Hexane.
Do not use Ketone type materials(ex. Acetone), Ethyl alcohol, Toluene, Ethyl acid or Methyl chloride. It might permanent damage to the polarizer due to chemical reaction.

(g) If the liquid crystal material leaks from the panel, it should be kept away from the eyes or mouth . In case of contact with hands, legs or clothes, it must be washed away thoroughly with soap.

(h) Protect the module from static , it may cause damage to the CMOS Gate Array IC.

(i) Use finger-stalls with soft gloves in order to keep display clean during the incoming inspection and assembly process.

(j) Do not disassemble the module.

(k) Do not pull or fold the lamp wire.

(l) Do not adjust the variable resistor which is located on the back side.

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

8.2 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 shall be stored in a dark place. It is prohibited to apply sunlight or fluorescent light during the store.

8.3 Operation

(a) Do not connect,disconnect the module in the " Power On" condition.

(b) Power supply should always be turned on/off by the item 6.5 " Power on/off sequence ".

(c) Module has high frequency circuits. Sufficient suppression to the electromagnetic interference shall 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 shall be a minimized length and be connected directly . The longer cable between the back-light and the inverter may cause lower luminance of lamp(CCFT) and may require higher startup voltage(Vs).

8.4 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. (the supply voltage variation, input voltage variation, variation in part contents and environmental temperature, so on) Otherwise the module may be damaged.

(d) If the module displays the same pattern continuously for a long period of time,it can be the situation when the image "sticks" to the screen.

(e) This module has its circuitry PCB's on the rear side and should be handled carefully in order not to be stressed.