SAMSUNG ELECTRONICS

Preliminary

TO :

DATE : April 01, 1999

SAMSUNG TFT-LCD

MODEL NO. : LTN150P1-L01

APPROVED BY : _____

CHECKED BY : _____

Notes :

This information described in the SPEC is preliminary and can be changed without prior notice

APPROVED BY : B. W. Lee

PREPARED BY : **Application Engineering Team**

SAMSUNG ELECTRONICS CO., LTD.

Preliminary

CONTENTS

Revision History

Preliminary

Date	Rev.No.	Page	Summary
Apr.01.1999	000		LTN150P1-L01 SXGA-Plus(1400X1050 pixel) MODEL WAS FIRST ISSUED

GENERAL DESCRIPTION

Preliminary

DESCRIPTION

LTN150P1-L01 is a color active matrix TFT (Thin Film Transistor) liquid crystal display (LCD) that uses amorphous silicon TFT as a switching devices. This model is composed of a TFT LCD panel, a driver circuit and a back-light system. The resolution of a 15.0″ contains 1400 x 1050 pixels and can display up to 262,144colors. 6 o'clock direction is the optimum viewing angle.

FEATURES

- Thin and light weight
- High contrast ratio
- SXGA-Plus (1400x1050 pixels) resolution
- Low power consumption
- DE (Data enable) only mode.
- LVDS Interface with 2 pixel / clock (2 channel)

APPLICATIONS

- Notebook PC and desktop monitors
- Display terminals for AV application products
- Monitors for Industrial machine
- If the usage of this product is not for PC application, but for others, please contact SEC.

GENERAL INFORMATION

ITEM	SPECIFICATION	UNIT	NOTE
Display area	304.5(H) x 228.4(V) (15.0″ diagonal)	mm	
Driver element	a-Si TFT active matrix		
Display colors	262,144		
Number of pixel	1,400 x 1050 (SXGA-Plus)	pixel	
Pixel arrangement	RGB vertical stripe		
Pixel pitch	0.2175(H) x 0.2175(V) (TYP.)	mm	
Display Mode	Normally white		
Surface treatment	HAZE (25), HARD-COATING 3H		

MECHANICAL INFORMATION

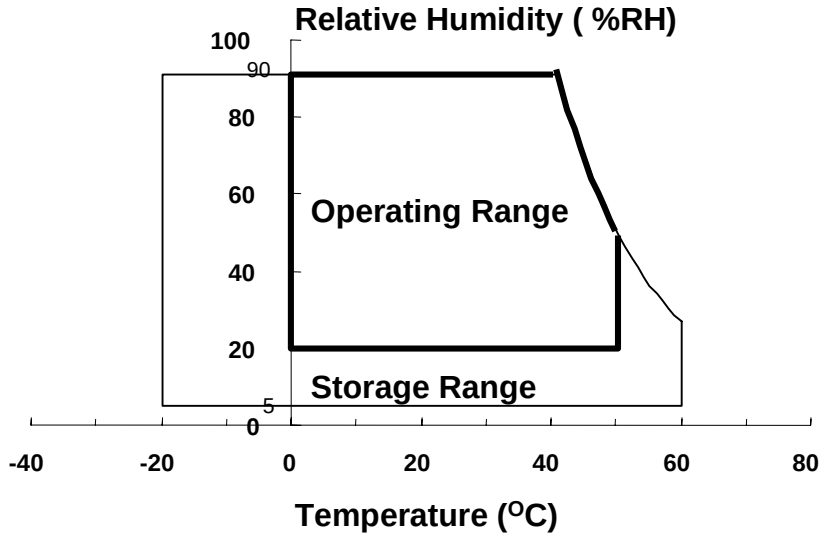
ITEM		MIN.	TYP.	MAX.	NOTE
Module size	Horizontal (H)	315.5	315.8	316.1	
	Vertical (V)	240.2	240.5	240.8	
	Depth (D)	-	(-)	7.5	
Weight		-	(-)	(700)	

1. ABSOLUTE MAXIMUM RATINGS

1.1 ABSOLUTE RATINGS OF ENVIRONMENT

ITEM	SYMBOL	MIN.	MAX.	UNIT	NOTE
Storage temperature	T_{STG}	(-20)	60	℃	(1)
Operating temperature (Temperature of glass surface)	T_{OPR}	0	50	℃	(1)
Shock (non-operating)	Snop	-	220	G	(2),(4)
Vibration (non-operating)	Vnop	-	1. 5	G	(3),(4)

Note (1) Temperature and relative humidity range are shown in the figure below.
90 % RH Max. (40 ℃ ≥ Ta)
Maximum wet - bulb temperature at 39 ℃ or less. (Ta > 40℃) No condensation.



(2) (2)ms, (half) sine wave, one time for ± X, ± Y, ± Z.
(3) (10) - (300) Hz, Sweep rate (10) min, (30)min for X,Y,Z.
(4) At testing Vibration and Shock, the fixture in holding the Module to be tested have to be hard and rigid enough so that the Module would not be twisted or bent by the fixture.

1.2 ELECTRICAL ABSOLUTE RATINGS

(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)
Logic Input Voltage	V_{IN}	Vss -0.3	VDD+0.3	V	(1)

NOTE (1) Within Ta = 25 ± 2 ℃

(2) BACK-LIGHT UNIT

Ta = 25 ± 2 ℃

ITEM	SYMBOL	MIN.	MAX.	UNIT.	NOTE
Lamp current	I_L	(2.0)	(7.5)	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.

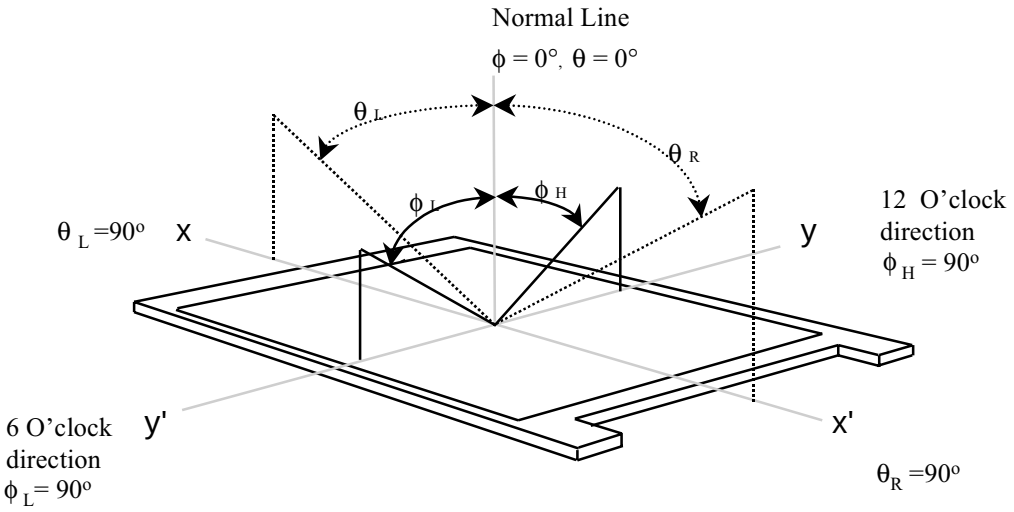
2. OPTICAL CHARACTERISTICS

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 (5).
Measuring equipment : TOPCON BM-5A

* Ta = 25 ± 2℃, V_{DD}=3.3V, fv= 60Hz, f_{DCLK}=54MHz, I_L = (5.0) mA

ITEM		SYMBOL	CONDITION	MIN.	TYP.	MAX.	UNIT	NOTE
Contrast Ratio (5 Points)		CR	ϕ = 0, θ = 0 Normal Viewing Angle	(180)	-	-		(1), (2), (5)
Response Time at Ta	Rising	T_R		-	(10)	(20)	msec	(1), (3)
	Falling	T_F		-	(30)	50		
Average Luminance of White (5 Points)		$Y_{L,AVE}$		(120)	(150)	-	cd/m^2	(1), (4)
Color Chromaticity (CIE)	Red	R_X		(0.585)	(0.615)	(0.645)		(1), (5)
		R_Y		(0.308)	(0.338)	(0.368)		
	Green	G_X		(0.267)	(0.297)	(0.327)		
		G_Y		(0.542)	(0.572)	(0.602)		
	Blue	B_X		(0.121)	(0.151)	(0.181)		
		B_Y		(0.087)	(0.117)	(0.147)		
	White	W_X		(0.283)	(0.313)	(0.343)		
		W_Y		(0.299)	(0.329)	(0.359)		
Viewing Angle	Hor.	θ_L	CR(at center point) ≥ 10	(40)	-	-	Degrees	
		θ_R		(40)	-	-		
	Ver.	ϕ_H		(15)	-	-		
		ϕ_L		(35)	-	-		
13 Points White Variation		δ_L		-	-	(2.0)		(6)

Note 1) Definition of Viewing Angle : Viewing angle range($10 \leq C/R$)

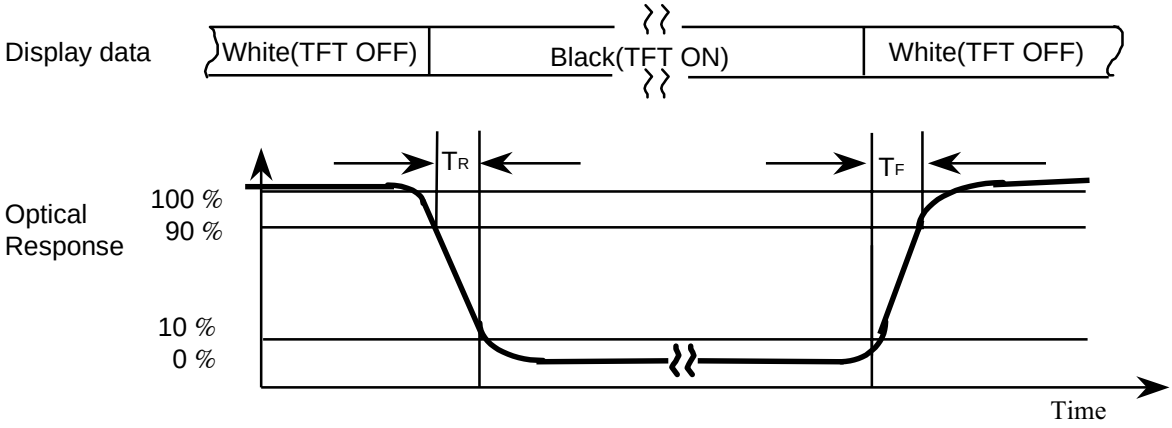


Note 2) Definition of Contrast Ratio (CR) : Ratio of gray max (Gmax) ,gray min (Gmin) at 5 points(4, 5, 7, 9, 10)

$$CR = \frac{CR(4) + CR(5) + CR(7) + CR(9) + CR(10)}{5}$$

POINTS : ④ , ⑤ , ⑦ , ⑨ , ⑩ at FIGURE OF NOTE 6)

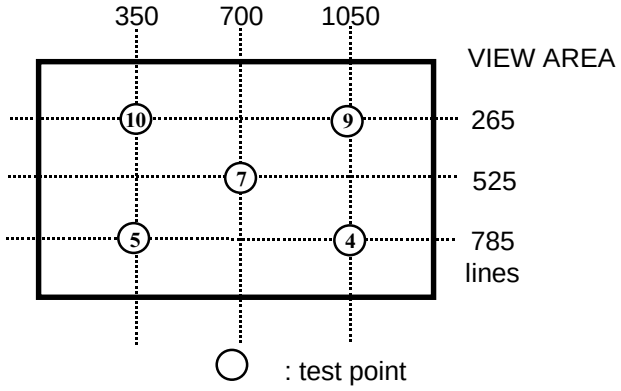
Note 3) Definition of Response time :



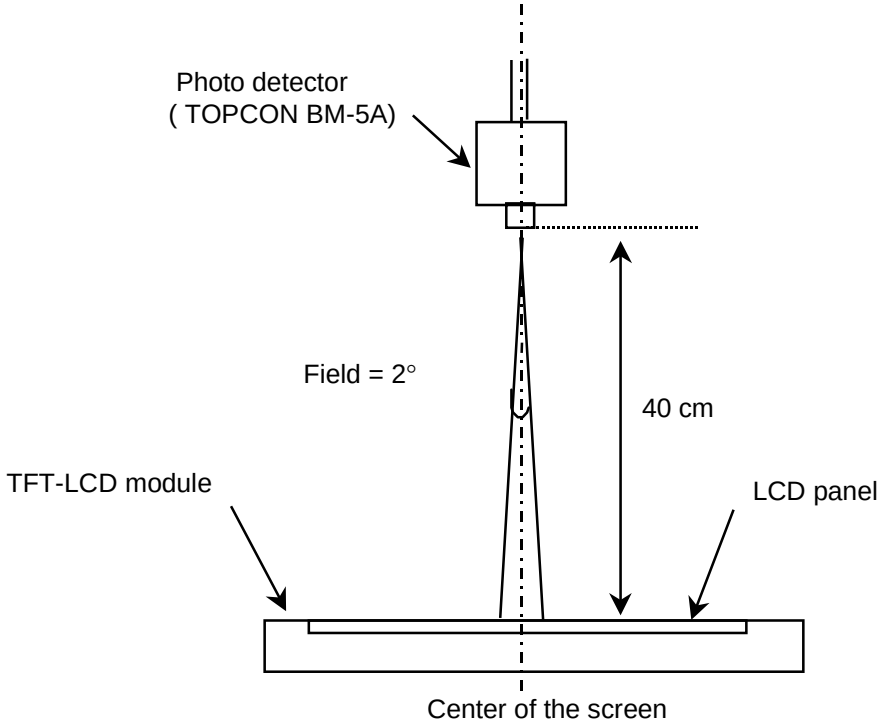
Note 4) Definition of Average Luminance of White : measure the luminance of white at 5 points.

Average Luminance of White ($Y_{L,AVE}$)

$$Y_{L,AVE} = \frac{Y_{L4} + Y_{L5} + Y_{L7} + Y_{L9} + Y_{L10}}{5}$$



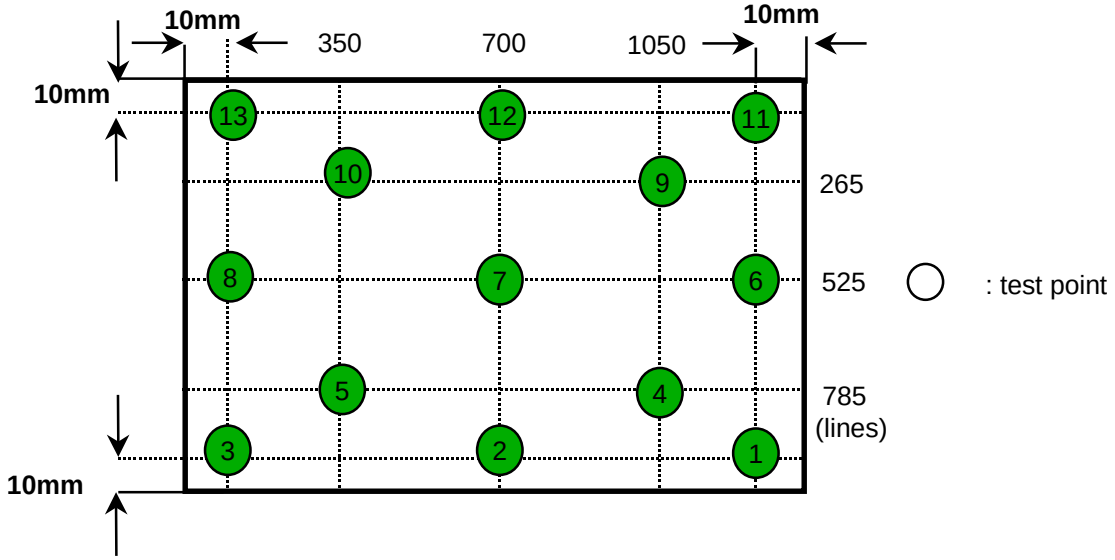
Note 5) After stabilizing and leaving the panel alone at a given temperature for 30 minutes, the measurement should be executed. Measurement should be executed in a stable, windless,and dark room.
30 minutes after lighting the back-light. This should be measured in the center of screen.
Lamp current : (5.0) mA
Environment condition : Ta = 25 ± 2 ℃



Optical characteristics measurement setup

Note 6) Definition of 13 points white variation (δ_W), CR variation(C_{VER}) [① ~ ⑬]

$$\delta_L = \frac{\text{Maximum luminance of 13 points}}{\text{Minimum luminance of 13 points}}$$



Preliminary

3. ELECTRICAL CHARACTERISTICS

3.1 TFT LCD MODULE

Ta = 25 ± 2%℃

ITEM		SYMBOL	MIN	TYP	MAX	UNIT	NOTE
Voltage of Power Supply		V_{DD}	3.0	3.3	3.6	V	
Differential Input Voltage for LVDS Receiver Threshold	High	V_{IH}	-	-	+100	mV	(1)
	Low	V_{IL}	-100	-	-	mV	
Vsync Frequency		fv	-	60	-	Hz	
Hsync Frequency		f_H	-	63.98	-	KHz	
Main Frequency		f_{DCLK}	-	54	-	MHz	
Rush Current		I_{RUSH}	-	-	(1.5)	A	(5)
Current of Power Supply	White	I_{DD}	-	TBD	-	mA	(2),(4)
	Mosaic		-	TBD	-	mA	(2),(4)
	V.stripe		-	TBD	(700)	mA	(2),(4)

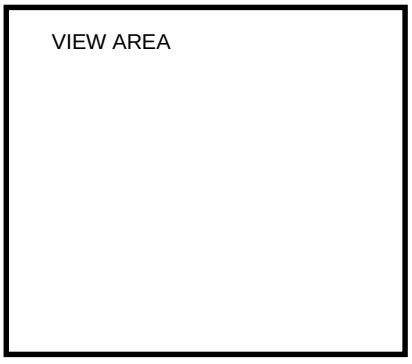
Note (1) Condition : V_{CM}=+1.2V(Common mode Voltage)

(2) f_V=60Hz, f_{DCLK} =54MHZ, Vdd = 3.3V , DC Current.

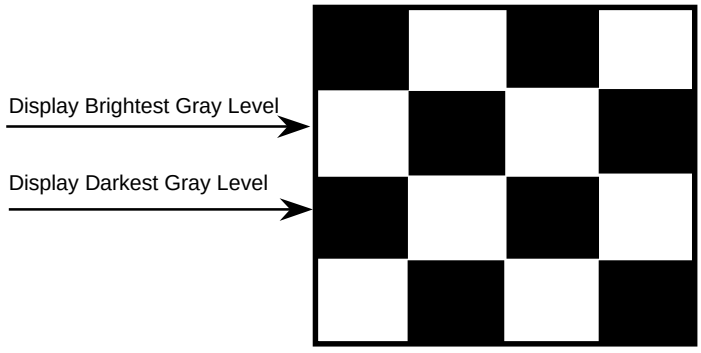
(3) 1 pixel /clock

(4) Power dissipation check pattern

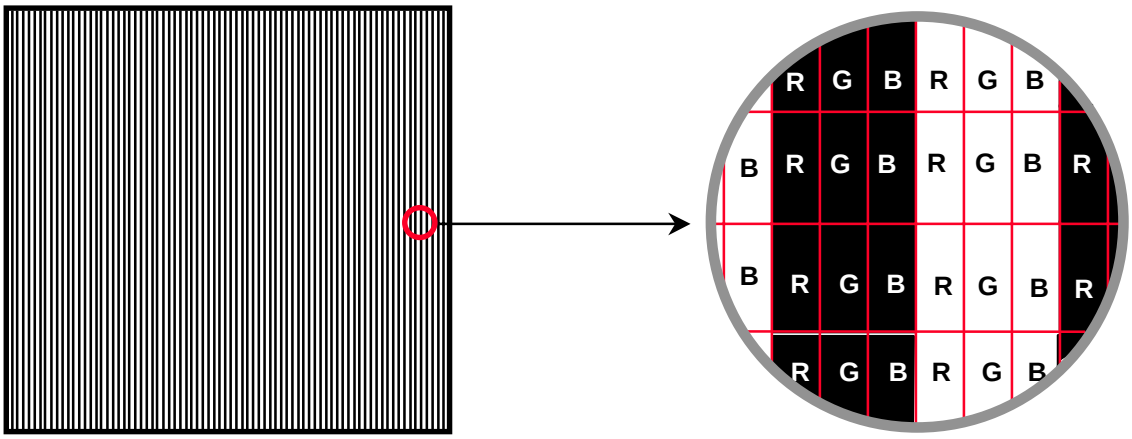
*a) White Pattern



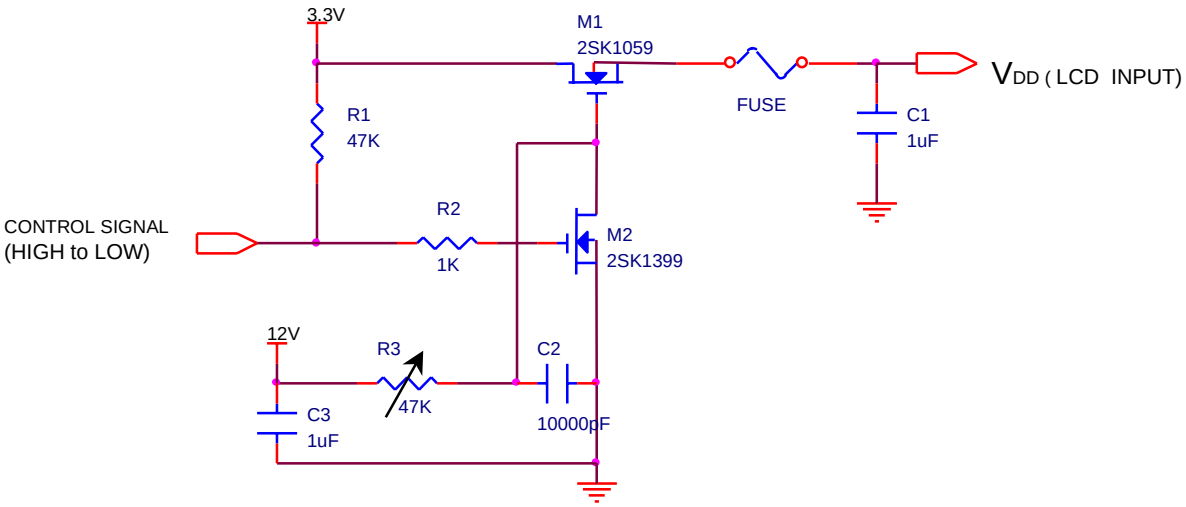
*b)Mosaic Pattern



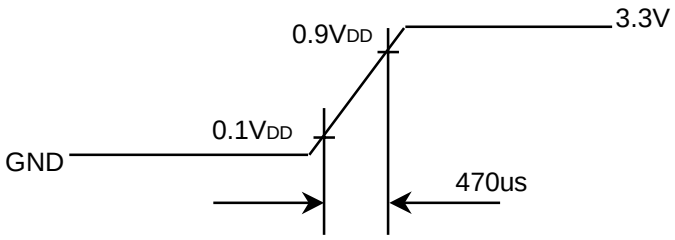
*c) Vertical stripe pattern



5) Rush current measurement condition



VDD rising time is 470us



3.2 BACKLIGHT UNIT

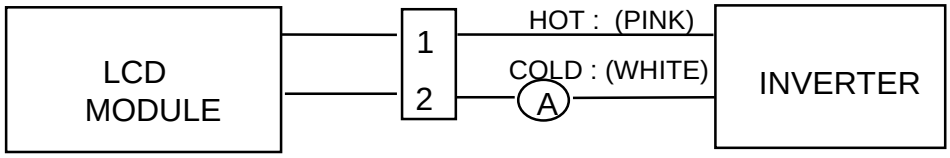
The back-light system is an edge - lighting type with a single CCFT (Cold Cathode Fluorescent Tube).
The characteristics of a single lamp are shown in the following tables.

INVERTER : TBD Ta=25 ± 2%℃

ITEM	SYMB	MIN	TYP	MAX	UNIT	NOTE
Lamp Current	I_L	-	(5.0)	-	mArms	(1)
Lamp Voltage	V_L	-	-	-	Vrms	I_L=5mA
Frequency	f_L	(50)	-	60	KHz	(2)
Power Consumption	P_L	-	-	-	W	(3), I_L=6mA
Operating Life Time	Hr	(10,000)	-	-	Hour	(4)
Startup Voltage	V_S	-	-	(1350) (25℃) (1600) (0℃)	Vrms	(5)

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 a high frequency current meter as shown below.



No 2 Pin is V_{LOW}. (TBD)

(2) Lamp frequency may produce interference with horizontal synchronous frequency and this 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.

(3) refer to I_L X V_L to calculate.

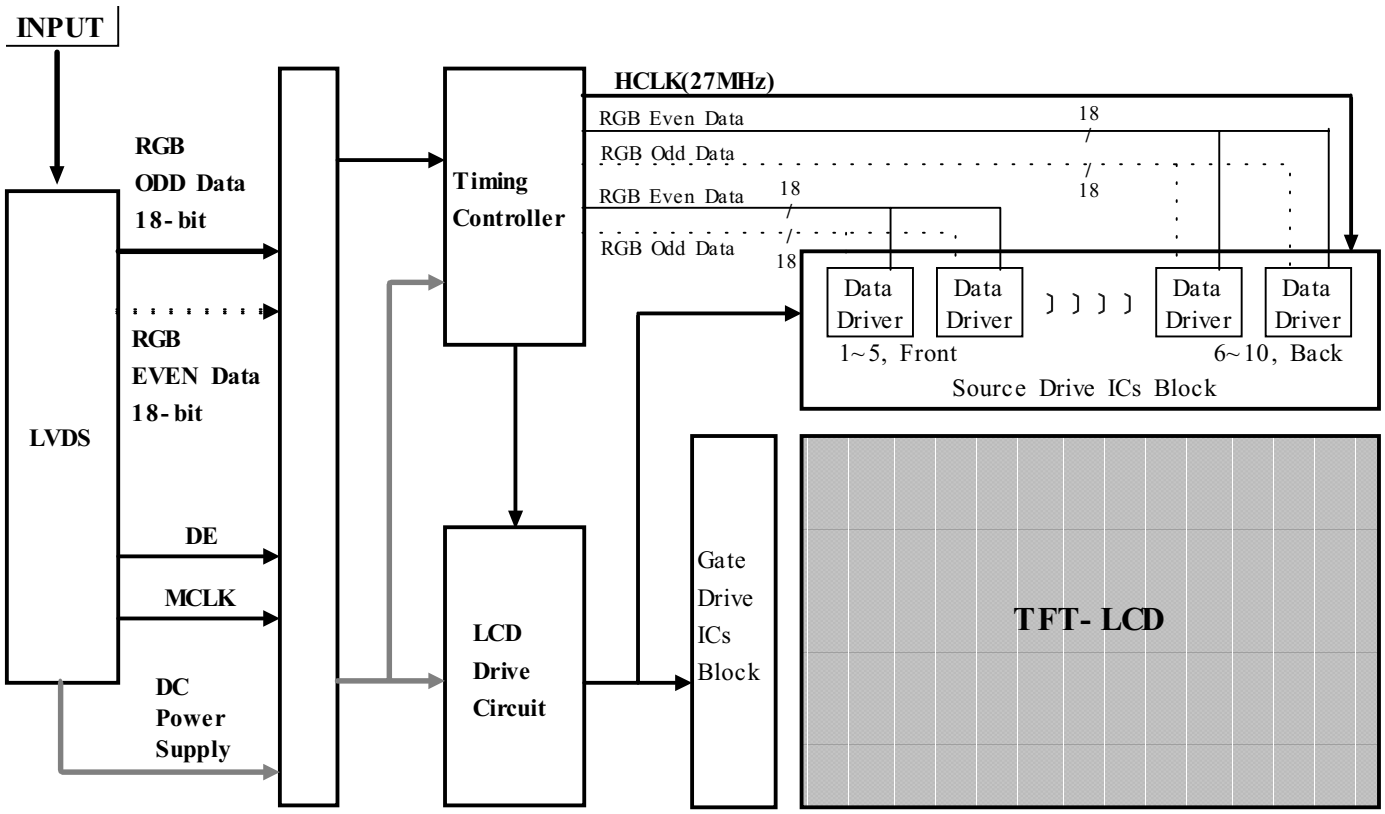
(4) Life time (Hr) of a lamp can be defined as the time in which it continues to operate under the condition Ta = 25 ± 2℃ and I_L = (TBD) mArms until one of the following event occurs.
1. When the brightness becomes 50% or lower than it's original.
2. When the Effective ignition length becomes 80% or lower than it's original value.
(Effective ignition length is defined as an area that has less than 70% brightness compared to the brightness in the center point.)

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

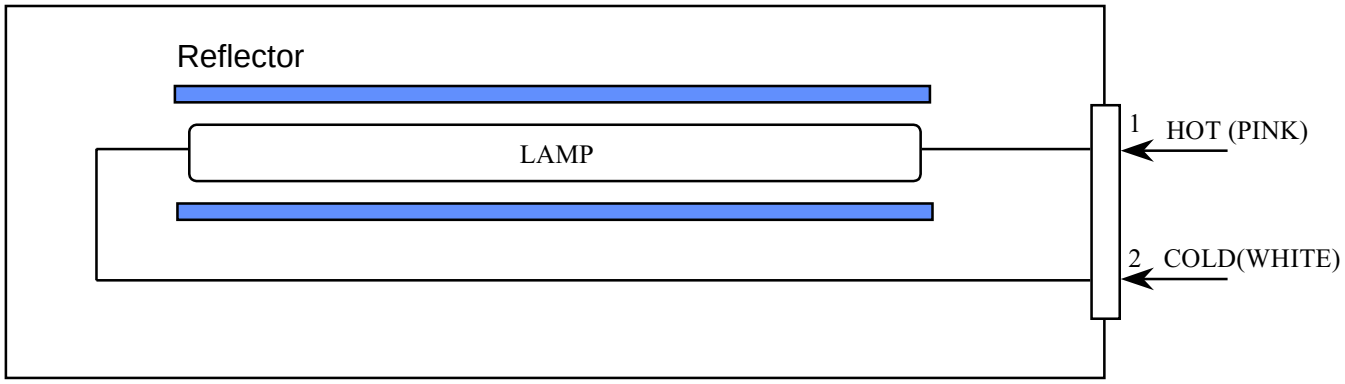
4. BLOCK DIAGRAM

4.1 TFT LCD MODULE

Connector : UJ FI-SEB20P-HF13



4.2 BACKLIGHT UNIT



Note) The output of the inverter may change according to the material of the reflector.

5. INPUT TERMINAL PIN ASSIGNMENT

5.1. Input Signal & Power (LVDS, Connector : UJ-FI-SEB-20P-HF13
Mating Connector : JAE FI-SE20M-HF)

PIN NO	SYMBOL	FUNCTION	POLARITY	REMARK
1	VDD	POWER SUPPLY +3.3V		
2	VDD	POWER SUPPLY +3.3V		
3	GND	GROUND		
4	GND	GROUND		
5	O_RxIN0-	LVDS Differential Data INPUT (Odd channel 0)	Negative	
6	O_RxIN0+	LVDS Differential Data INPUT (Odd channel 0)	Positive	
7	O_RxIN1-	LVDS Differential Data INPUT (Odd channel 1)	Negative	
8	O_RxIN1+	LVDS Differential Data INPUT (Odd channel 1)	Positive	
9	O_RxIN2-	LVDS Differential Data INPUT (Odd channel 2)	Negative	
10	O_RxIN2+	LVDS Differential Data INPUT (Odd channel 2)	Positive	
11	O_RxCLK-	LVDS Differential Data INPUT (Odd Clock)	Negative	
12	O_RxCLK+	LVDS Differential Data INPUT (Odd Clock)	Positive	
13	E_RxIN0-	LVDS Differential Data INPUT (Even channel 0)	Negative	
14	E_RxIN0+	LVDS Differential Data INPUT (Even channel 0)	Positive	
15	E_RxIN1-	LVDS Differential Data INPUT (Even channel 1)	Negative	
16	E_RxIN1+	LVDS Differential Data INPUT (Even channel 1)	Positive	
17	E_RxIN2-	LVDS Differential Data INPUT (Even channel 2)	Negative	
18	E_RxIN2+	LVDS Differential Data INPUT (Even channel 2)	Positive	
19	E_RxCLK-	LVDS Differential Data INPUT (Even Clock)	Negative	
20	E_RxCLK+	LVDS Differential Data INPUT (Even Clock)	Positive	

5.2 LVDS Interface : Transmitter DS90CF363 or Compatible

LVDS for Odd pixel

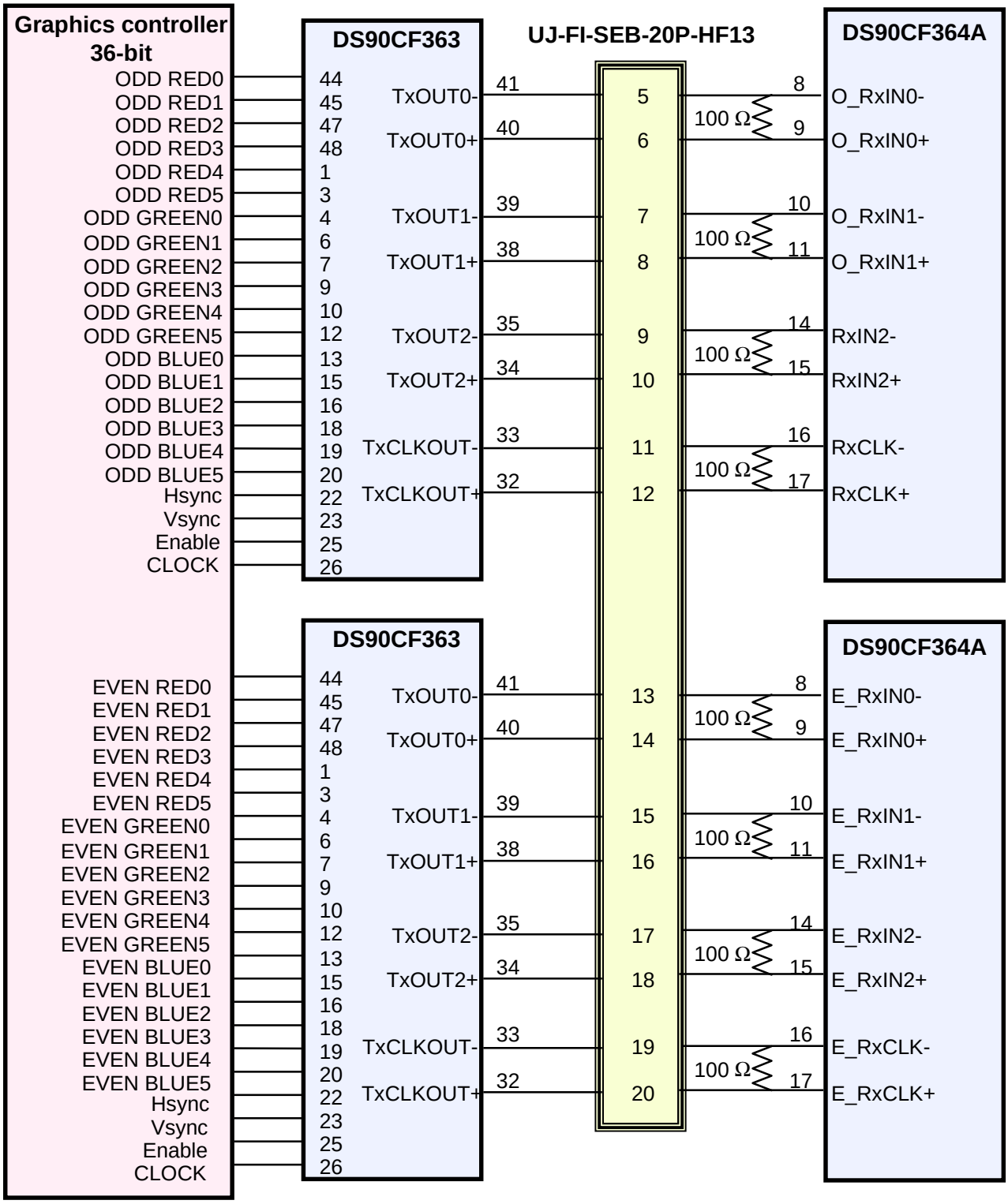
Pin No.	Name	RGB Signal	Pin No.	Name	RGB Signal
44	TxIN0	RO0	12	TxIN11	GO5
45	TxIN1	RO1	13	TxIN12	BO0
47	TxIN2	RO2	15	TxIN13	BO1
48	TxIN3	RO3	16	TxIN14	BO2
1	TxIN4	RO4	18	TxIN15	BO3
3	TxIN5	RO5	19	TxIN16	BO4
4	TxIN6	GO0	20	TxIN17	BO5
6	TxIN7	GO1	22	TxIN18	Hsync
7	TxIN8	GO2	23	TxIN19	Vsync
9	TxIN9	GO3	25	TxIN20	DE
10	TxIN10	GO4	26	TxCLK IN	Clock

LVDS for Even pixel

Pin No.	Name	RGB Signal	Pin No.	Name	RGB Signal
44	TxIN0	RE0	12	TxIN11	GE5
45	TxIN1	RE1	13	TxIN12	BE0
47	TxIN2	RE2	15	TxIN13	BE1
48	TxIN3	RE3	16	TxIN14	BE2
1	TxIN4	RE4	18	TxIN15	BE3
3	TxIN5	RE5	19	TxIN16	BE4
4	TxIN6	GE0	20	TxIN17	BE5
6	TxIN7	GE1	22	TxIN18	Hsync
7	TxIN8	GE2	23	TxIN19	Vsync
9	TxIN9	GE3	25	TxIN20	DE
10	TxIN10	GE4	26	TxCLK IN	Clock

Preliminary

Flat Link Interface



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

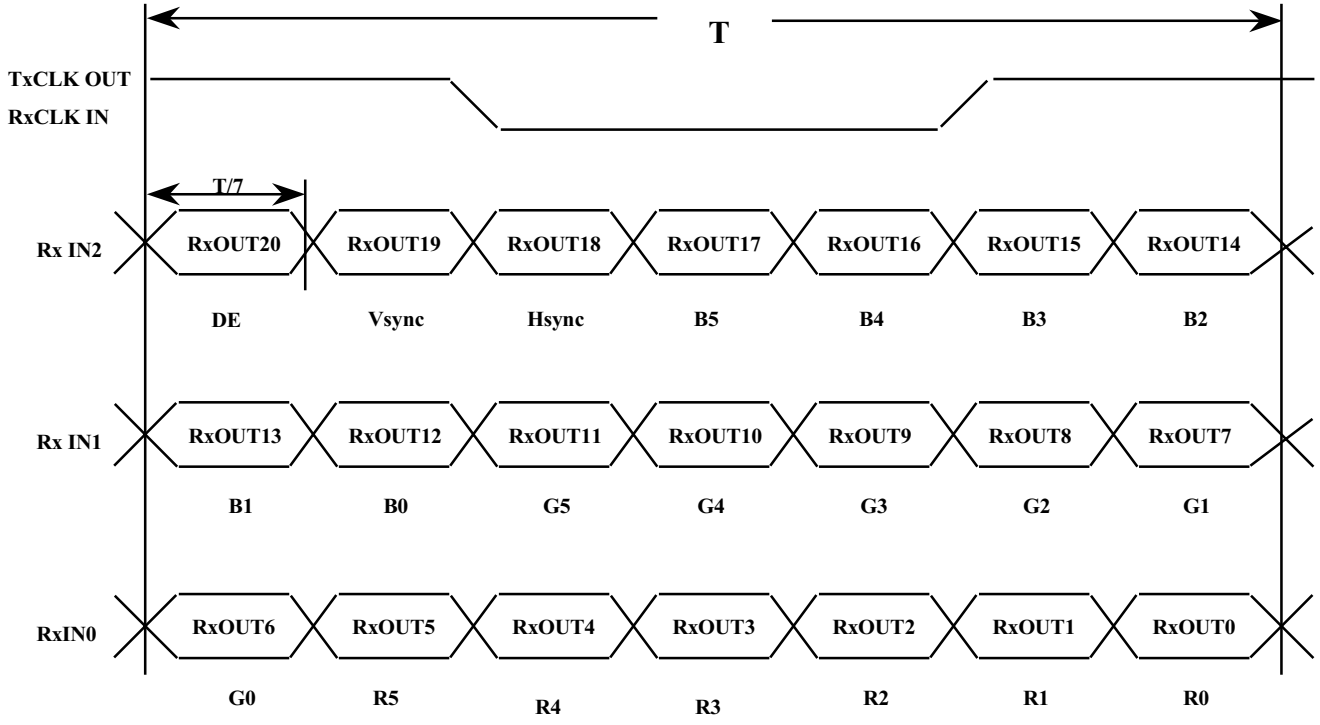
5.3 BACK LIGHT UNIT

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

Pin NO.	Symbol	Color	Function
1	HOT	PINK	High Voltage
2	COLD	WHITE	Low Voltage

5.4 Timing Diagrams of LVDS For Transmission

LVDS Receiver : DS90CF364A or Compatible



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

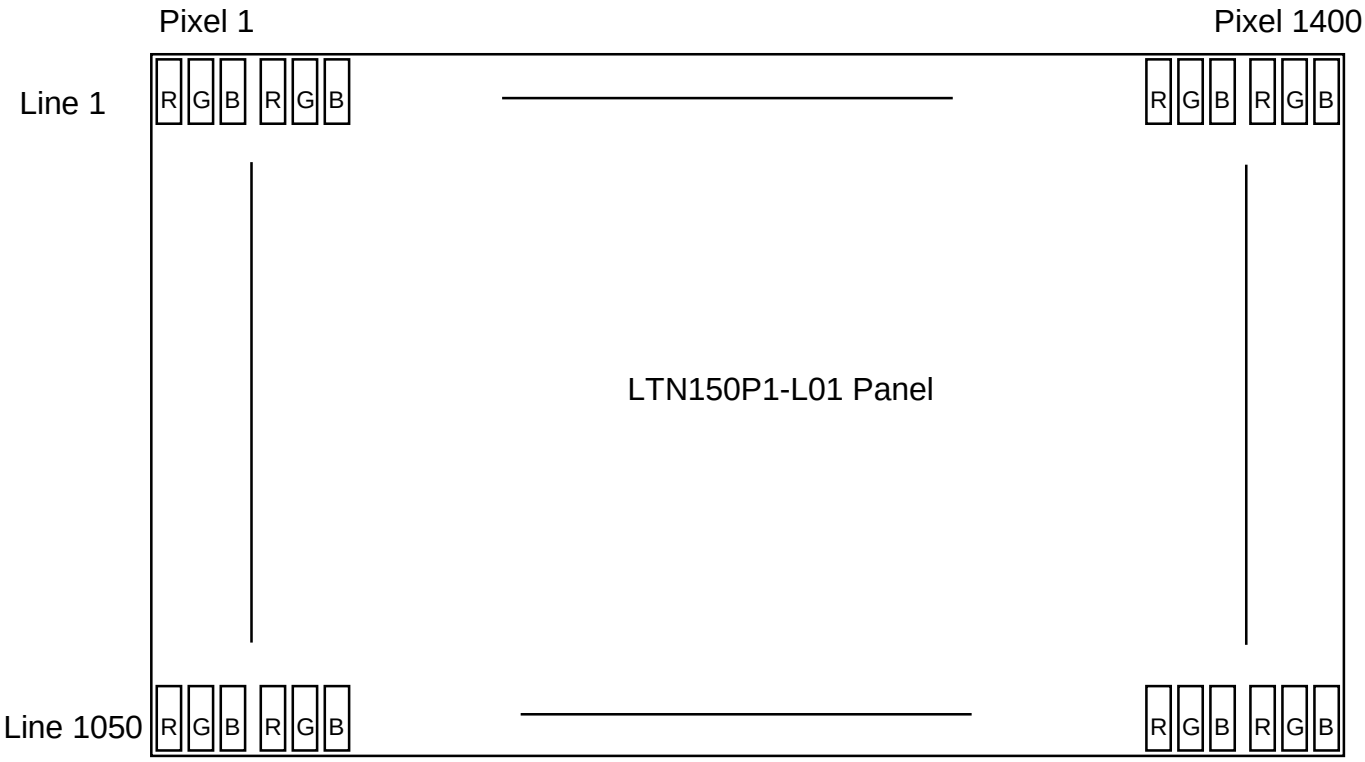
COLOR	DISPLAY	DATA SIGNAL																		GRAY SCALE LEVEL
		RED						GREEN						BLUE						
		R0	R1	R2	R3	R4	R5	G0	G1	G2	G3	G4	G5	B0	B1	B2	B3	B4	B5	
BASIC COLOR	BLACK	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	-
	BLUE	0	0	0	0	0	0	0	0	0	0	0	0	1	1	1	1	1	1	-
	GREEN	0	0	0	0	0	0	1	1	1	1	1	1	0	0	0	0	0	0	-
	CYAN	0	0	0	0	0	0	1	1	1	1	1	1	1	1	1	1	1	1	-
	RED	1	1	1	1	1	1	0	0	0	0	0	0	0	0	0	0	0	0	-
	MAGENTA	1	1	1	1	1	1	0	0	0	0	0	0	1	1	1	1	1	1	-
	YELLOW	1	1	1	1	1	1	1	1	1	1	1	1	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	-
GRAY SCALE OF RED	BLACK	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	R1
		0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	R2
		:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	R3~R60
		:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	
	⊿ LIGHT	1	0	1	1	1	1	0	0	0	0	0	0	0	0	0	0	0	0	R61
		0	1	1	1	1	1	0	0	0	0	0	0	0	0	0	0	0	0	R62
	RED	1	1	1	1	1	1	0	0	0	0	0	0	0	0	0	0	0	0	R63
GRAY SCALE OF GREEN	BLACK	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	1	0	0	0	0	0	0	0	0	0	0	0	G1
		0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	G2
		:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	G3~G60
		:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	
	⊿ LIGHT	0	0	0	0	0	0	1	0	1	1	1	1	0	0	0	0	0	0	G61
		0	0	0	0	0	0	0	1	1	1	1	1	0	0	0	0	0	0	G62
	GREEN	0	0	0	0	0	0	1	1	1	1	1	1	0	0	0	0	0	0	G63
GRAY SCALE OF BLUE	BLACK	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	1	0	0	0	0	0	B1
		0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	B2
		:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	B3~B60
		:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	
	⊿ LIGHT	0	0	0	0	0	0	0	0	0	0	0	0	1	0	1	1	1	1	B61
		0	0	0	0	0	0	0	0	0	0	0	0	0	1	1	1	1	1	B62
	BLUE	0	0	0	0	0	0	0	0	0	0	0	0	1	1	1	1	1	1	B63

Note

(1) Definition of Gray : Rn : Red Gray, Gn : Green Gray, Bn : Blue Gray (n = Gray level)

(2) Input Signal : 0 = Low level voltage, 1 = High level voltage

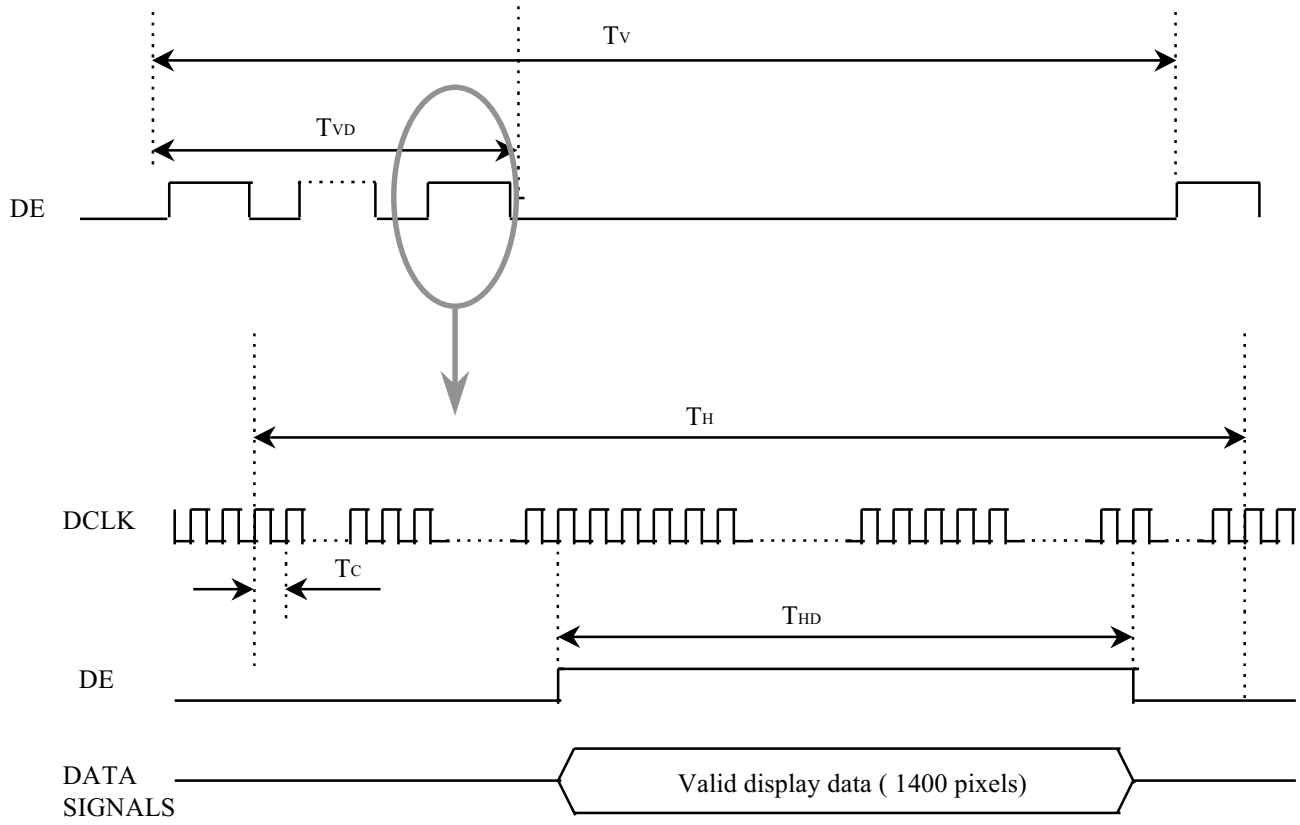
5.6 PIXEL FORMAT



6. INTERFACE TIMING

6.1 Timing Parameters

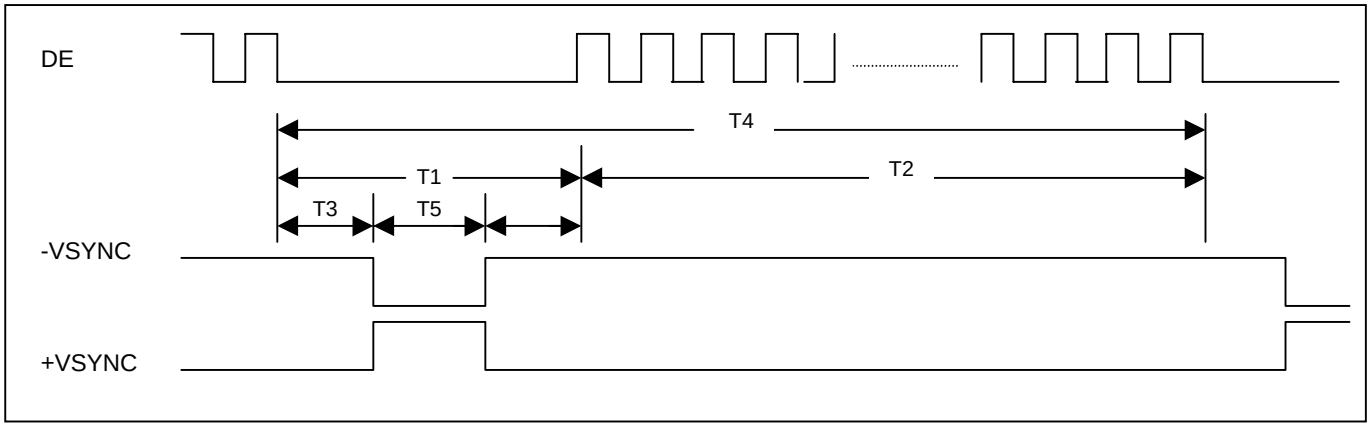
Signal	Item	Symbol	MIN	TYP	MAX	Unit	Note
Main Clock	Frequency	1/Tc		54		MHz	
Vertical Active Display Term	Display Period	T_{VD}		1050		lines	
One Line Scanning Time	Cycle	T_H		1688		clocks	
Horizontal Active Display Term	Display Period	T_{HD}		1400		clocks	



Note : All input condition(level & timing) for LXD 3657 are the same with those of NS DS90CF384 or compatible.

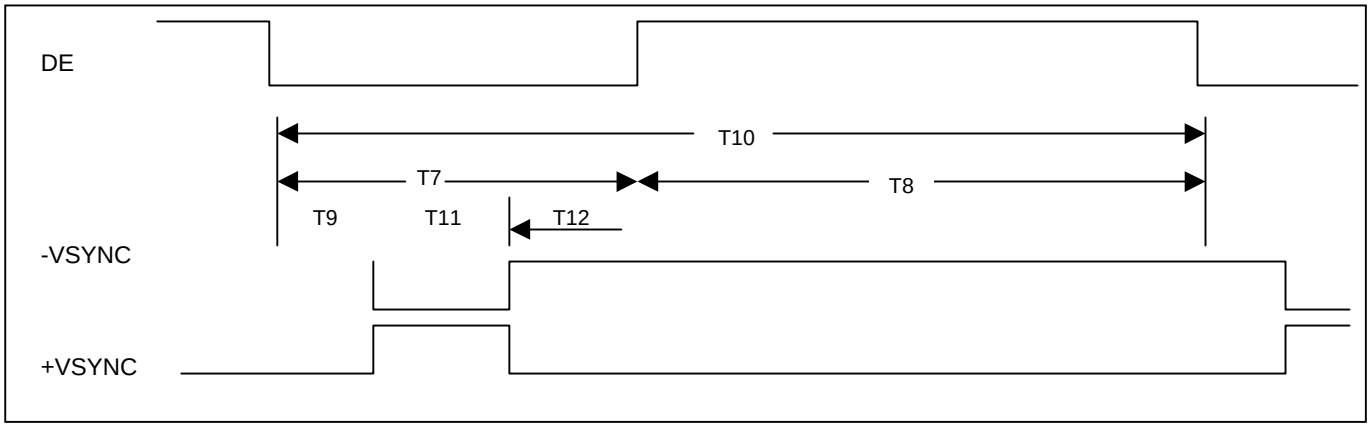
6.2 Timing diagrams of interface signal

Vertical Timing



Support Mode	T1 Vertical Blanking	T2 Active Field	T3 VSYNC Front Porch	T4 VSYNC Frame time	T5 VSYNC Width	T6 VSYNC Back Porch
1400X1050 at 60Hz (H line rate:15.63us)	0.250ms (16 lines)	16.411ms (1050 lines)	0.016ms (1 line)	16.661ms (1066 lines)	0.047ms (3 lines)	0.188ms (12 lines)

Horizontal Timing

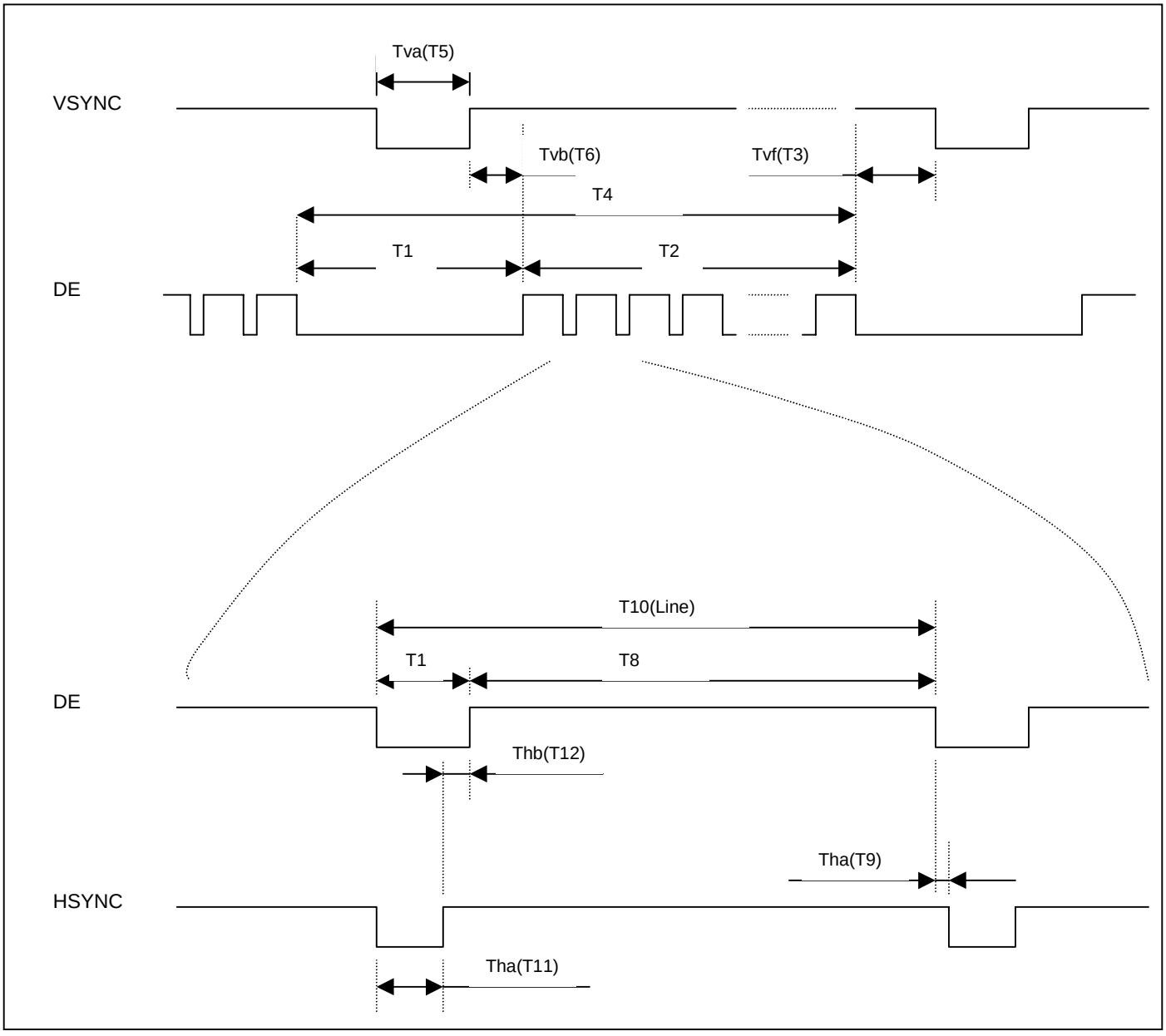


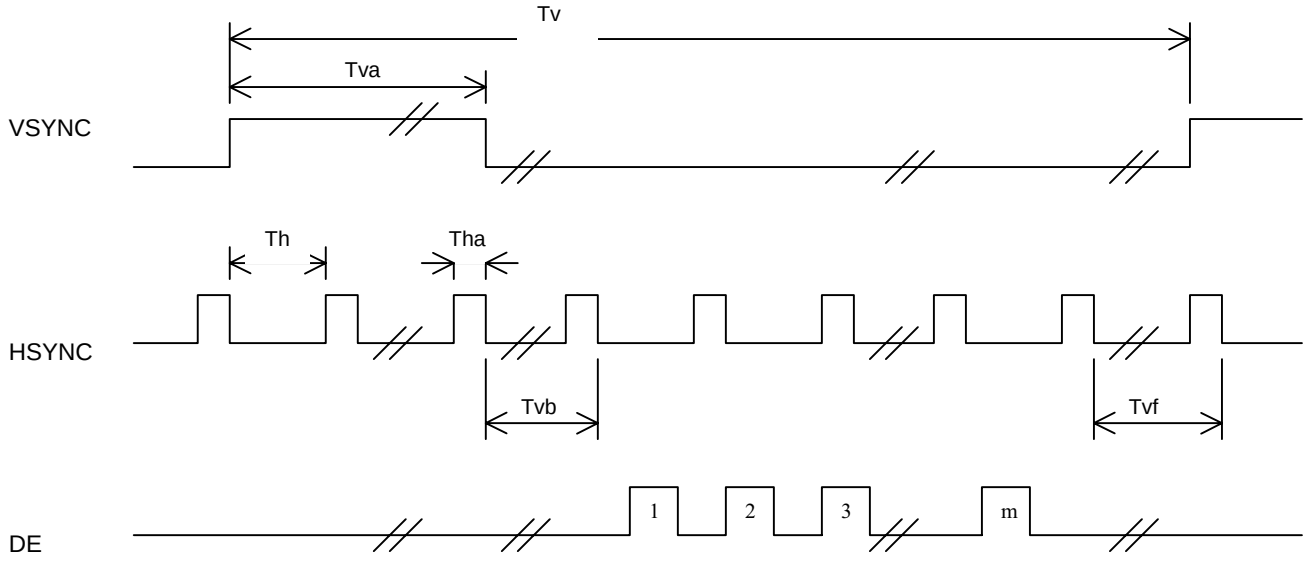
Support Mode	T7 Horizontal Blanking	T8 Active Field	T9 HSYNC Front Porch	T10 HSYNC Frame time	T11 HSYNC Width	T2 HSYNC Back Porch
1400X1050 at 60Hz (Dot clock:108MHz)	0.667us (288 dots)	12.963us (1400 dots)	0.444us (48 dots)	15.63us (1688 dots)	1.037us (112 dots)	1.185ms (128 dots)

Timing Characteristics

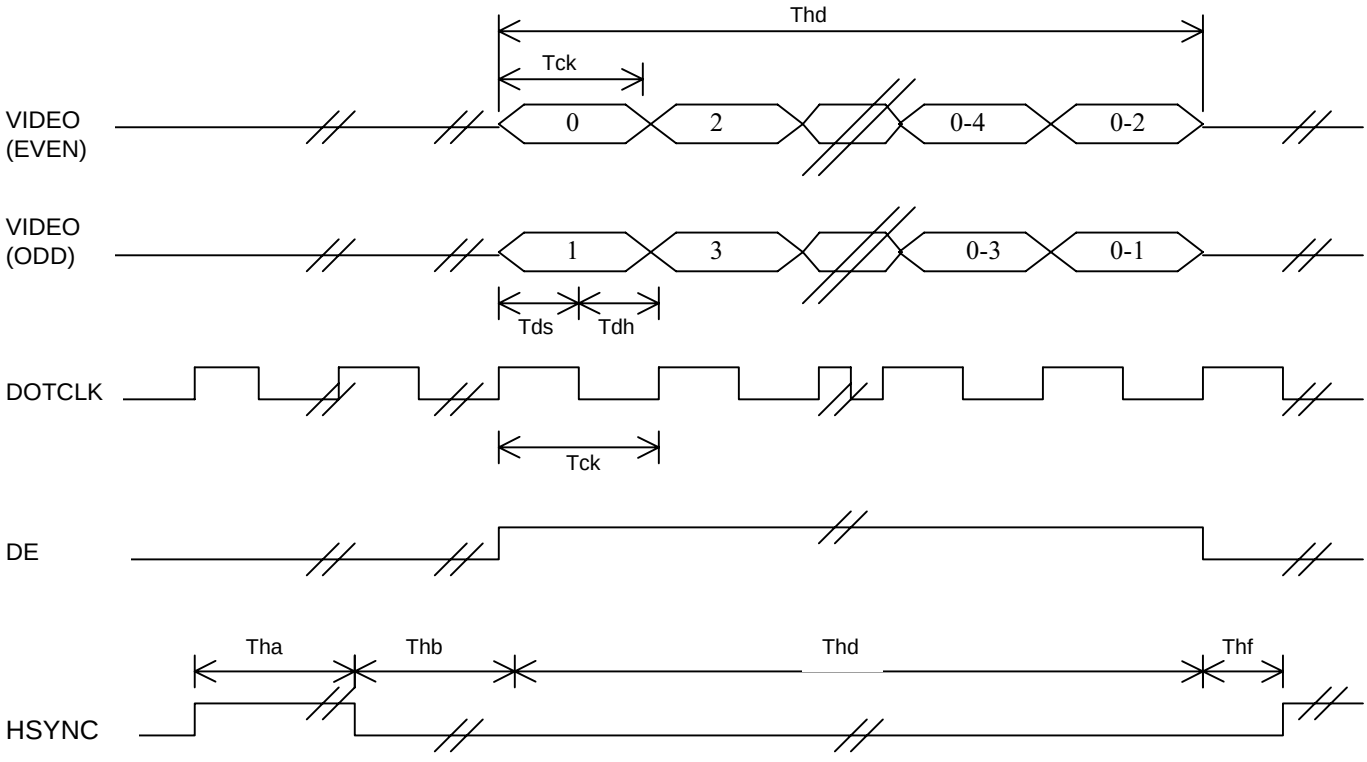
Signal	Item	Symbol	Min.	Typ.	Max.	Unit
DTCLK	Frequency	Fdck	-	54	-	MHz
DTCLK	Cycle	Tck	17.5	18.5	-	ns
DTCLKWH	Clock high width	Twch	4	-	-	ns
DTCLKWL	Clock low width	Twcl	4	-	-	ns
+V-Sync	Frame Rate	1/Tv	56.25	60	61	Hz
+V-Sync	Cycle	Tv	16.39	16.67	17.78	ms
+V-Sync	Cycle	Tv	1059	1066	2047	lines
+V-Sync	Active level	Tva	15.78	46.7	-	us
+V-Sync	Active level	Tva	1	3	-	lines
+V-Sync	V-back porch	Tvb	7	12	63	lines
+V-Sync	V-front porch	Tvf	1	1	-	lines
+DE	V-Line	m	-	1050	-	lines
+H-Sync	Scan Rate	1/Th	-	63.98	69.51	KHz
+H-Sync	Cycle	Th	-	15.63	-	us
+H-Sync	Cycle	Th	820	844	1023	Tck
+H-Sync	Active level	Tha	-	1037	-	us
+H-Sync	Active level	Tha	10	56	-	Tck
+H-Sync	Back porch	Thb	8	64	-	Tck
+H-Sync	Front porch	Thf	8	24	-	Tck
+DE	Display	Thd	-	12.96	-	us
+DATA	Data Odd/Even	n	-	700	-	Tck
+DATA	Data setup	Tds	3	-	-	ns
+DATA	Data hold	Tdh	6	-	-	ns

Interface Timing Definition





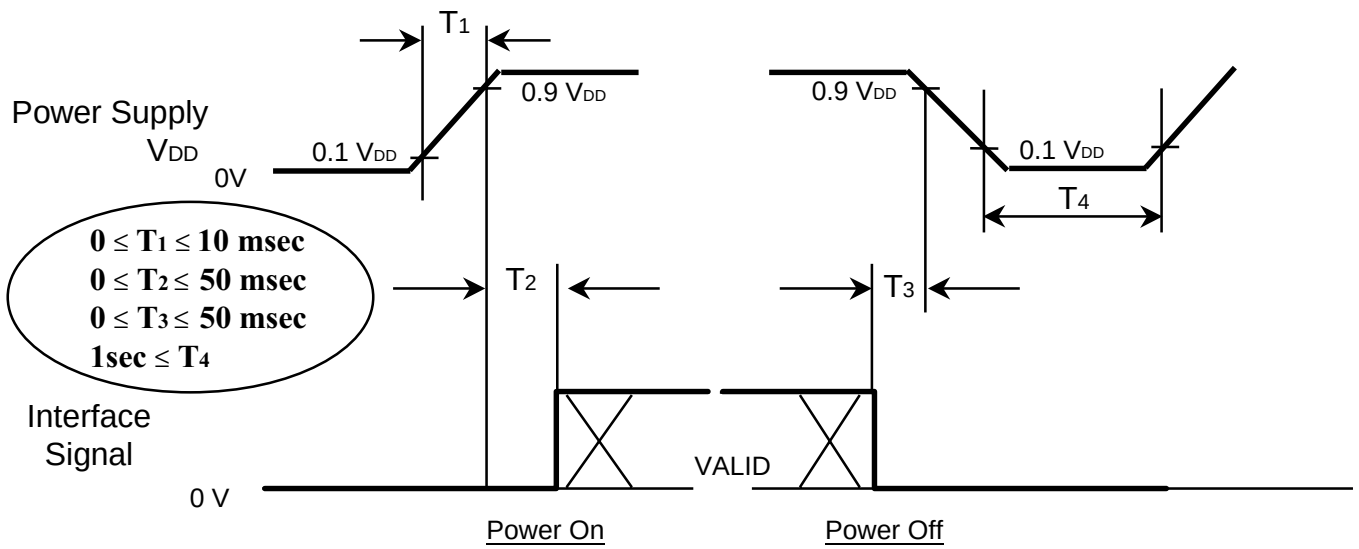
Vsync,Hsync and Display Timing



Video Signal and Dot clock

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 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.

Preliminary

7. Outline Dimension

Refer to attached file ‘LTN150P1-L01(Drawing).PDF’.

8. GENERAL PRECAUTIONS

Preliminary

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(Isoprophyl 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 C-MOS Gate Array IC.

(i) Use fingerstalls 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) Protection film for polarizer on the module shall be slowly peeled off just before use so that the electrostatic charge can be minimized.

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

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.

3. OPERATION

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

(b) Power supply should always be turned on/off by following item 6.3 " 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 backlight connector and its inverter power supply shall be a minimized length and be connected directly . The longer cable between the backlight and the inverter may cause lower luminance of lamp(CCFT) and may require higher startup voltage(Vs).

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.