



ELECTRONICS

Preliminary

TO :

DATE :

**SAMSUNG TFT-LCD**  
**MODEL NO. : LT121SS-121**

NOTE :

The information described in this SPEC is preliminary and can be changed without prior notice.

Reference Product Spec:

Product Specification No.
SP0029- 01

PREPARED BY : Application Engineering Group

**SAMSUNG ELECTRONICS CO., LTD.**

## CONTENTS

Revision History	----- ( 3 )
General Description	----- ( 4 )
1. Absolute Maximum Ratings	----- ( 5 )
1.1 Absolute Ratings of Environment	
1.2 Electrical Absolute Ratings	
2. Optical Characteristics	----- ( 7 )
3. Electrical Characteristics	----- ( 11 )
3.1 TFT LCD Module	
3.2 Backlight Unit	
4. Block Diagram	----- ( 14 )
4.1 TFT LCD Module	
4.2 Backlight Unit	
5. Input Terminal Pin Assignment	----- ( 15 )
5.1 Input Signal & Power	
5.2 LVDS Interface	
5.3 Backlight Unit	
5.4 Input Signals, Basic Display Colors and Gray Scale of Each Color.	
5.5 Pixel format	
6. Interface Timing	----- ( 20 )
6.1 Timing Parameters	
6.2 Timing Diagrams of interface Signal	
6.3 Power ON/OFF Sequence	
7. Outline Dimension	----- ( 23 )
8. General Precaution	----- ( 24 )

**REVISION HISTORY**

Preliminary

Date	Rev.No.	Page	Summary
Feb.01.1997	000		LT121SS-121 model was First issued.
Nov.24.1997	001	5	<b><u>-Added Contents</u></b>
		6	-'Temperature & Humidity' Graph
		11	-the Lamp Current MIN. value 2.0mA
		13	-Vsync/Hsync/Main Frequency
		19	-Notes
		20	-PIXEL FORMAT
		21	-'Timing Parameters' items:Data setup/hold time, Data Enable
		24	-Signal Transition Timing
		25	-'Reliability Test'
		26	-'Packing' is added
			-'Marking & Others' is added
		6	<b><u>Deleted Contents</u></b>
			-the 'Electro-static Durability' item
		7	-the 'Lamp Voltage' item
		9	-the 'Cross Modulation' item
		11	-Note5) Definition of Cross Modulation
			-Common-mode input voltage
		7	<b><u>Changed Contents</u></b>
		13	-the Optical Characteristics' value
		14	-Lamp Voltage value:710 . 680
			-The drawing of Back Light UNIT:Reflector sheet
		22	-'GND' . 'COLD'
			-The contents of Note

## GENERAL DESCRIPTION

Preliminary

### DESCRIPTION

LT121SS-121 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 backlight system. The resolution of a 12.1. contains 800x600 pixels and can display up to 262,144 colors. 6 o'clock direction is the optimum viewing angle.

### FEATURES

- Thin - Light weight
- High contrast ratio
- SVGA (800x600 pixels) resolution
- Low power consumption
- DE (Data enable) only mode.
- 3.3V LVDS (FPD Link) Interface with 1 pixel / clock : NS DS90CF384

### 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	246.0(H) x 184.5(V) (12.1.diagonal)	mm	
Driver element	a-si TFT active matrix		
Display colors	262,144		
Number of pixel	800 x 600	pixel	
Pixel arrangement	RGB vertical stripe	mm	
Pixel pitch	0.3075(H) x 0.3075(V) (TYP.)		
Display Mode	Normally white		
Surface treatment	HAZE 25, HARD-COATING 3H		

Mechanical Information

ITEM		MIN.	TYP.	MAX.	NOTE
Module size	Horizontal (H)	274.5	275	275.5	
	Vertical (V)	198.8	199.3	199.8	
	Depth (D)	-	-	6.8	
Weight		-	-	460	

**1. ABSOLUTE MAXIMUM RATINGS**

**1.1 ABSOLUTE RATINGS OF ENVIRONMENT**

ITEM	SYMBOL	MIN.	MAX.	UNIT	NOTE
Storage temperate	T <sub>STG</sub>	-25	60	°C	(1)
Operating temperate (Temperature of glass surface)	T <sub>OPR</sub>	0	50	°C	(1)
Shock ( nonoperating )	Snop	-	( 100 )	G	(2),(4)
Vibration (nonoperating)	Vnop	-	( 1.0 )	G	(3),(4)

Note (1) Temperature and relative humidity range are shown in the figure below.

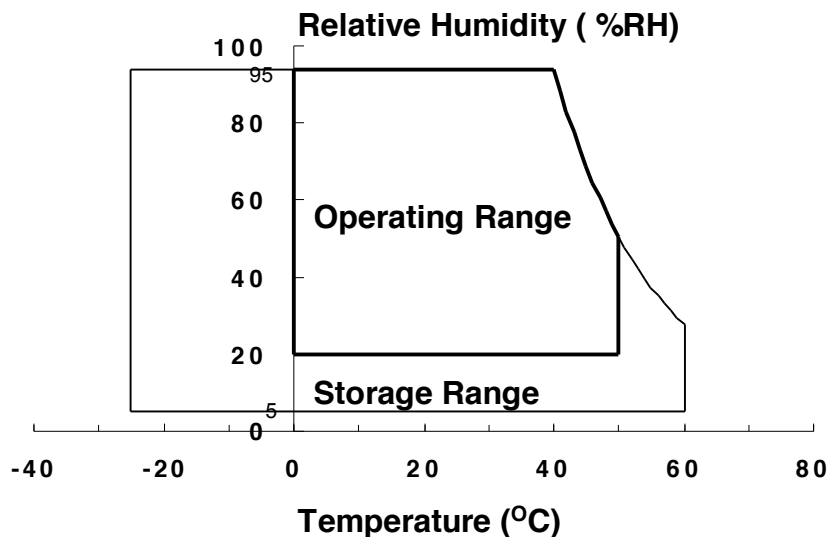
95 % RH Max. ( 40 °C . Ta)

Maximum wet - bulb temperature at 39 °C or less. (Ta > 40 °C) No condensation.

(2) (6 )ms, sine wave, one time for ±X,±Y,±Z.

(3) ( 10 ) - ( 55 ) - ( 10 ) Hz, Sweep rate ( 2.5 ) min, ( 120 ) 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

( V<sub>SS</sub> =GND= 0 V )

ITEM	SYMBOL	MIN.	MAX.	UNIT	NOTE
Power Supply Voltage	V <sub>DD</sub>	V <sub>SS</sub> - 0.3	4.0	V	(1)
Logic Input Voltage	V <sub>IN</sub>	V <sub>SS</sub> - 0.3	V <sub>DD</sub> + 0.3	V	(1)

NOTE (1) Within the operating temperature.

### (2) BACK-LIGHT UNIT

T<sub>a</sub> = 25 ± 2 °C

ITEM	SYMBOL	MIN.	MAX.	UNIT.	NOTE
Lamp current	I <sub>L</sub>	2.0	5.5	mArms	(1)
Lamp Frequency	F <sub>L</sub>	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

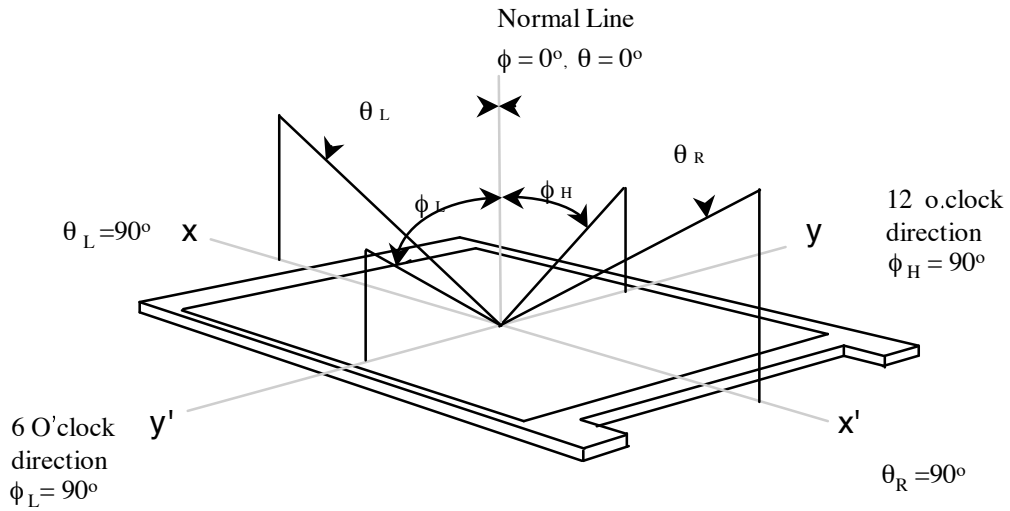
The following items are measured under stable conditions. The optical characteristics should be measured in a dark room or equivalent state with the methods shown in Note (5).

Measuring equipment : TOPCON BM-5A

\*  $T_a = 25 \pm 2^\circ\text{C}$  ,  $V_{DD} = 3.3\text{V}$  ,  $f_v = 60\text{Hz}$  ,  $f_{DCLK} = 40\text{MHz}$  ,  $I_L = 3.5\text{mA}$

ITEM	SYMBOL	CONDITION	MIN.	TYP.	MAX.	UNIT	NOTE
Contrast Ratio (5 Points)	CR		100	-	-		(1),(2), (5),(6)
Response Time at $T_a$	Rising	$T_R$	-	20	50	msec	(1), (3)
	Falling	$T_F$	-	30	70		
Average Luminance of White (5 Points)	$Y_{L,AVE}$		70	-	-	cd/m <sup>2</sup>	(1), (4)
Color Chromaticity (CIE)	Red	$R_x$	$\phi = 0,$ $\theta = 0$  Normal Viewing Angle	0.538	0.568	0.598	(1), (5)
		$R_y$		0.320	0.350	0.380	
	Green	$G_x$		0.271	0.301	0.331	
		$G_y$		0.512	0.542	0.572	
	Blue	$B_x$		0.121	0.151	0.181	
		$B_y$		0.094	0.124	0.154	
	White	$W_x$		0.258	0.288	0.318	
		$W_y$		0.282	0.312	0.342	
Viewing Angle	Hor.	$\theta_L$	CR( at ceter point) .10	45	-	-	Degrees
		$\theta_R$		45	-	-	
	Ver.	$\phi_H$		10	-	-	
		$\phi_L$		30	-	-	
13 Points White Variation	.L		-	-	2.0		(6)

Note 1) Definition of Viewing Angle : Viewing angle range (10= C/R )

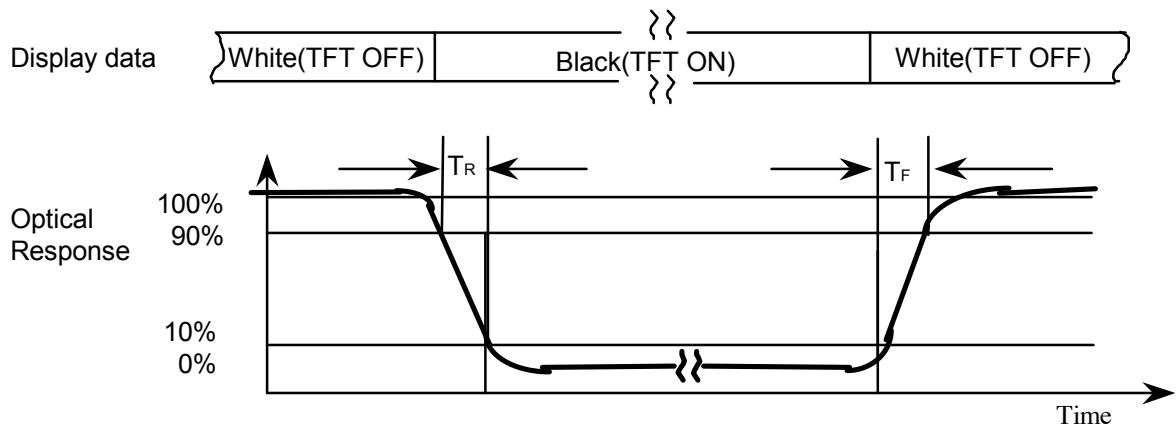


Note 2) Definition of Contrast Ratio (CR) : Ratio of gray max (Gmax) ,gray min (Gmin) at 5 points(4, 5, 7, 9, 10)

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

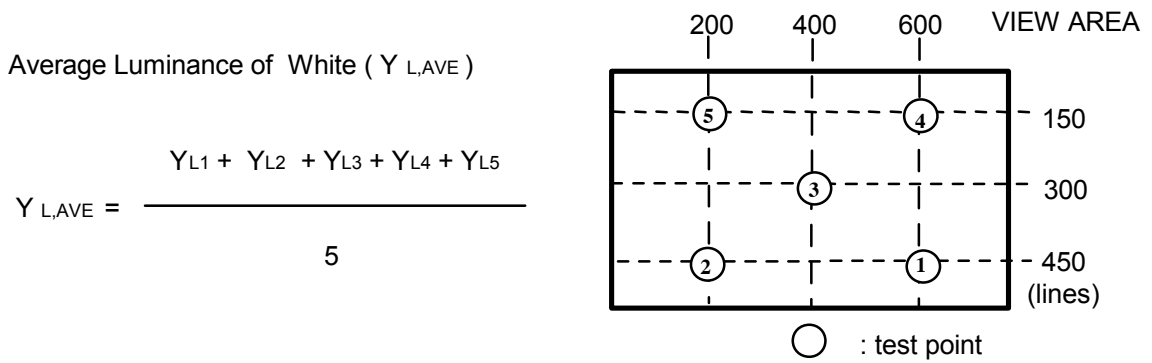
POINTS : (4) , (5) , (7) , (9) , (10) at FIGURE OF NOTE 6)

Note 3) Definition of Response time :

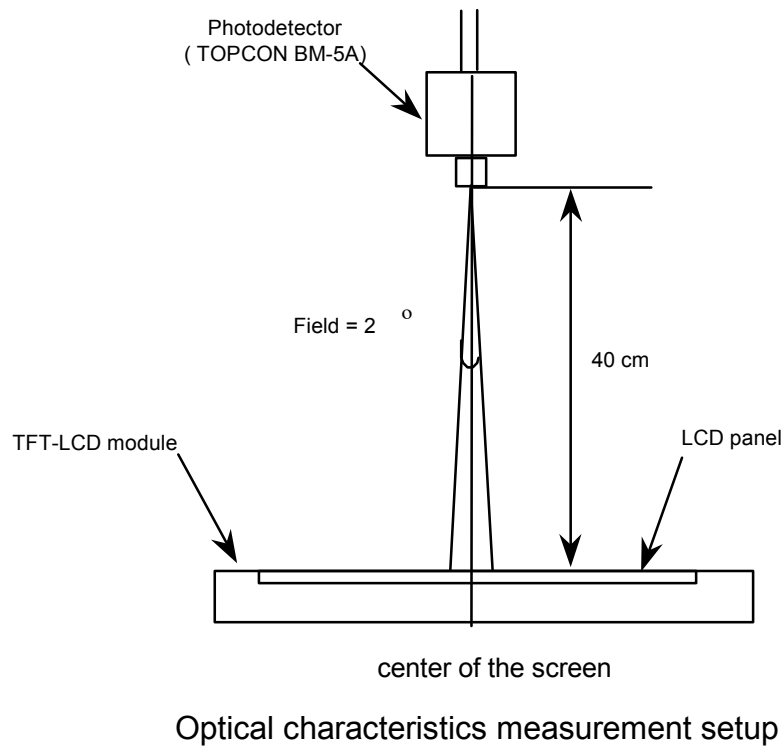




Note 4) Definition of Average Luminance of White : measuring the luminance of white at 5 points.

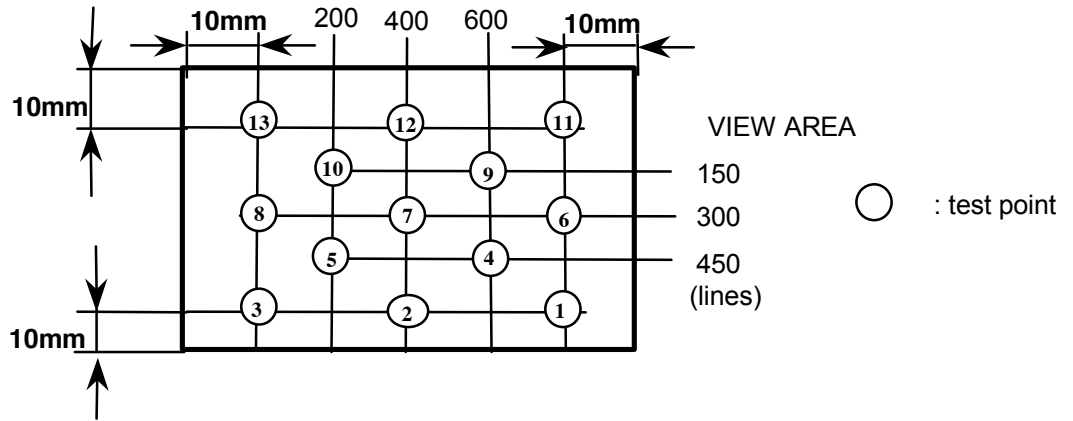


Note 5) Leaving the panel alone at a given temperature for 30 minutes and wait another 30 minutes after turning on the back light before the measurement execute in a stable, windless, and dark room.  
 Lamp current : 3.5 mA  
 Environment condition :  $T_a = 25^{\circ}\text{C} \pm 2^{\circ}\text{C}$



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

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



### 3. ELECTRICAL CHARACTERISTICS

Preliminary

#### 3.1 TFT LCD MODULE

Ta=25°C ±2 °C

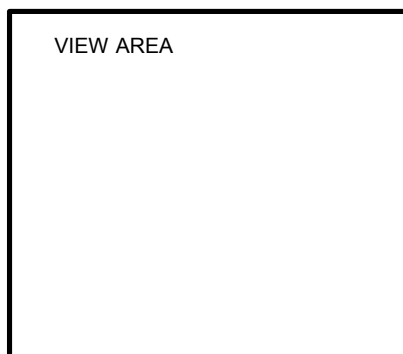
ITEM	SYMBOL	MIN	TYP	MAX	UNIT	NOTE	
Voltage of Power Supply	V <sub>DD</sub>	3.0	3.3	3.6	V		
(Range of Input Signal)	V <sub>in</sub>	( 0 )	( - )	( 2.4 )	V	(LVDS Signal)	
(Differential Input Threshold Voltage)	(High)	( V <sub>th</sub> )	-	-	+100	mV	V <sub>cm</sub> =1.2V
	(Low)	( V <sub>tl</sub> )	-100	-	-	mV	
( Input Current )	(High)	( I <sub>iH</sub> )	-	-	( ±10 )	.	( V <sub>in</sub> =2.4V V <sub>DD</sub> =5.5V )
	(Low)	( I <sub>iL</sub> )	-	-	( ±10 )	.	( V <sub>in</sub> =0V V <sub>DD</sub> =5.5V )
Termination Resistance	R <sub>t</sub>	-	(100)	-	.		
Vsync Frequency	f <sub>v</sub>	-	60	-	Hz		
Hsync Frequency	f <sub>H</sub>	-	37.879	-	kHz		
Main Frequency	f <sub>DCLK</sub>	38	40	42	MHz		
Rush Current	I <sub>RUSH</sub>	-	-	1.5	A	(4)	
Current of Power Supply	White	I <sub>DD</sub>	-	178	-	mA	(2)(3) *a
	Mosaic		-	212	-	mA	(2)(3) *b
	V.Stripe		-	288	330	mA	(2)(3) *c

Note (1) Display data pins and timing signal pins should be connected.(GND = 0V)

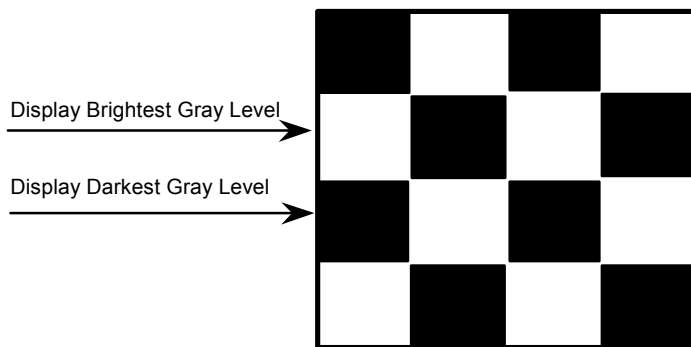
(2) f<sub>v</sub>= 60 Hz, f<sub>DCLK</sub> = 40 MHz, V<sub>DD</sub> = 3.3 V, DC Current.

(3) Power dissipation pattern.

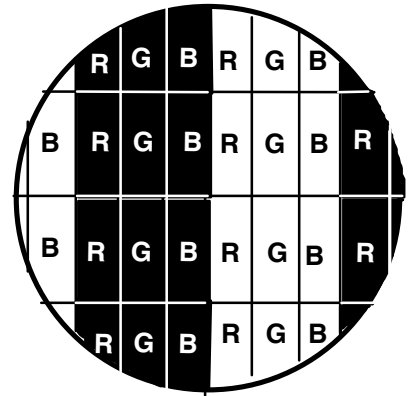
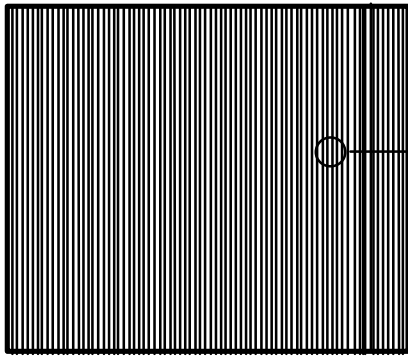
\*a) White Pattern



\*b)Mosaic Pattern

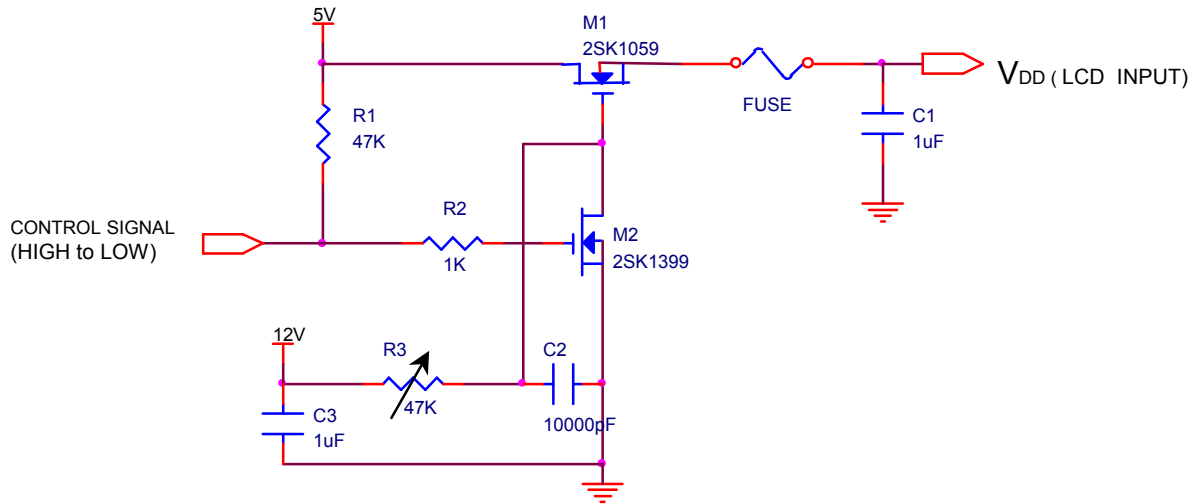


\*c) Vertical stripe pattern



(4) Measurement Conditions

V<sub>DD</sub> rising time : 470.



### 3.2 BACK-LIGHT UNIT

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

INVERTER : SIC-130

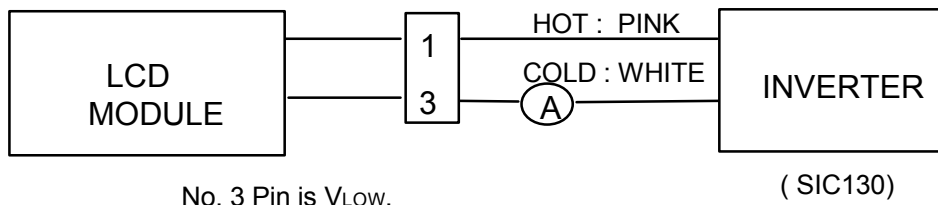
LAMP :

Ta=25°C ±2 °C

ITEM	SYMB	MIN	TYP	MAX	UNIT	NOTE
Lamp Current	I <sub>L</sub>	2.0	3.5	5.5	mArms	(1)
Lamp Voltage	V <sub>L</sub>	-	680	-	V <sub>rms</sub>	I <sub>L</sub> = 3.5mA
Frequency	f <sub>L</sub>	40	45	60	KHz	(2)
Power Consumption	P <sub>L</sub>	-	2.40	-	W	(3),I <sub>L</sub> =3.5mA
Operating Life Time	Hr	10,000	-	-	Hour	(4)
Startup Voltage	V <sub>s</sub>	-	-	1010 (25.)	V <sub>rms</sub>	(5)
				1320 (0 .)		

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 backlight, 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 backlight 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.

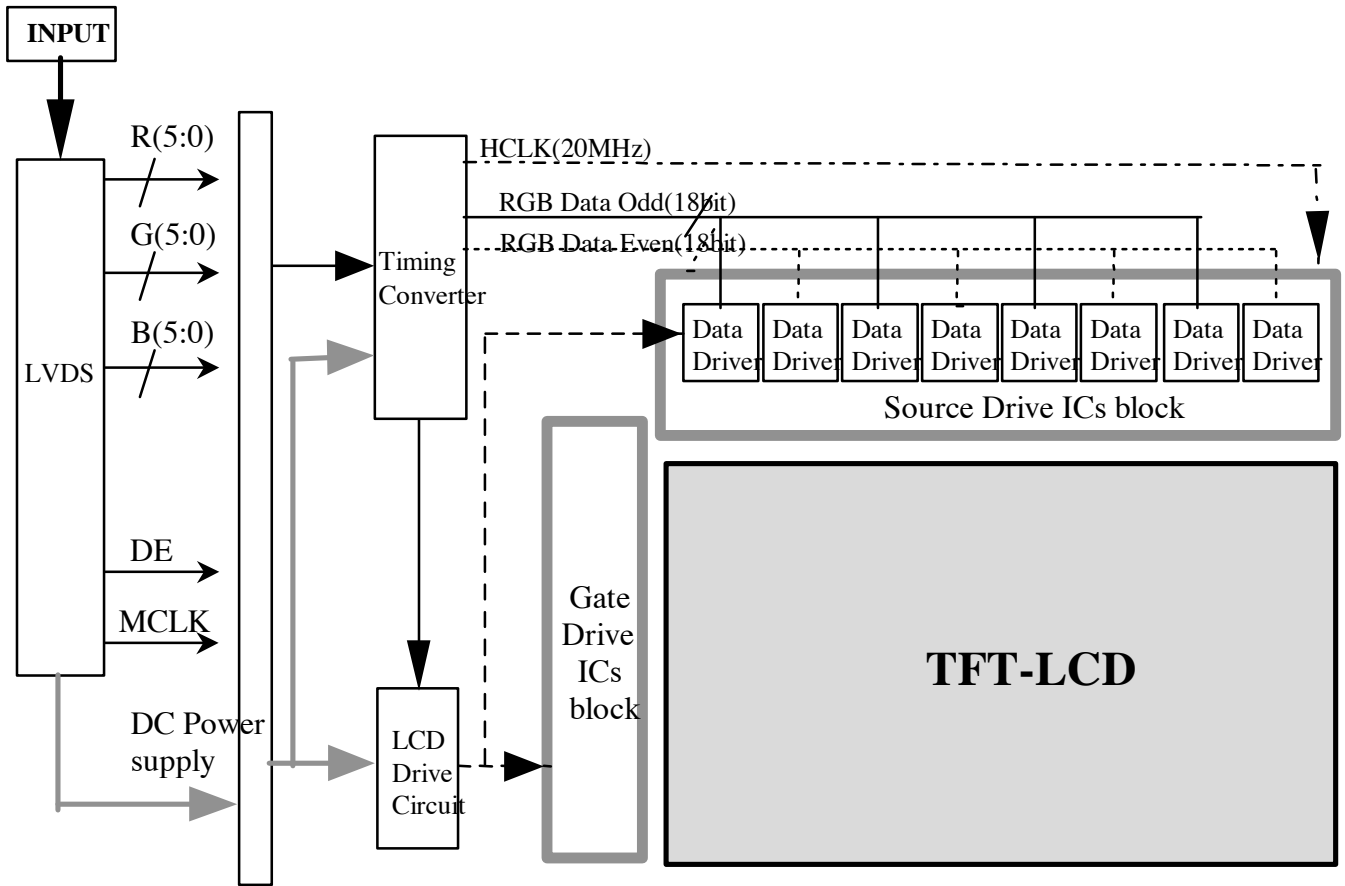
Note (1) Lamp current is measured with a high frequency current meter as shown below.



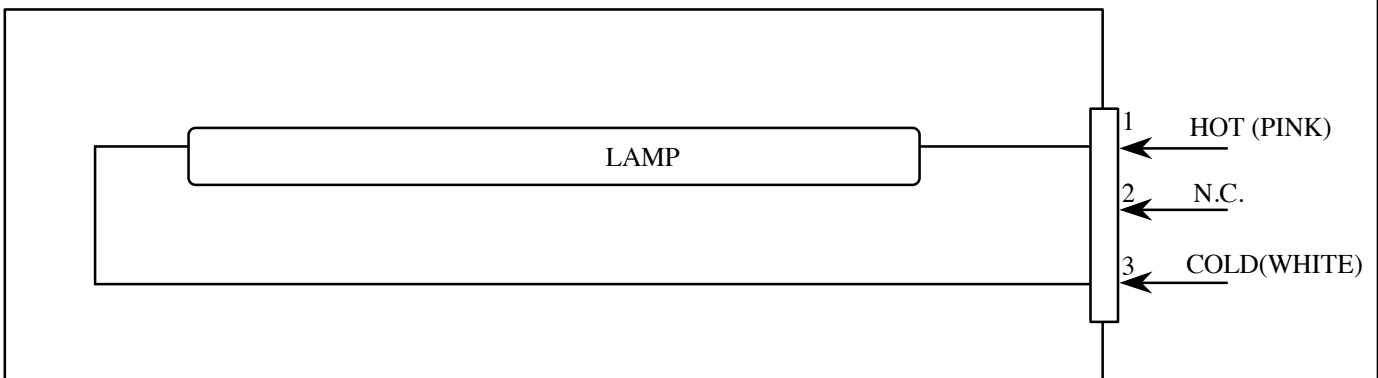
- (2) Lamp frequency may produce interference with horizontal synchronous frequency and this may cause line flow on the display. Therefore lamp frequency should be detached from the horizontal synchronous frequency and its harmonics as far as possible in order to avoid interference.
- (3) refer to I<sub>L</sub> × V<sub>L</sub> 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. and I<sub>L</sub> = 3.5 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



#### 4.2 BACK-LIGHT UNIT



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

## 5. INPUT TERMINAL PIN ASSIGNMENT

Preliminary

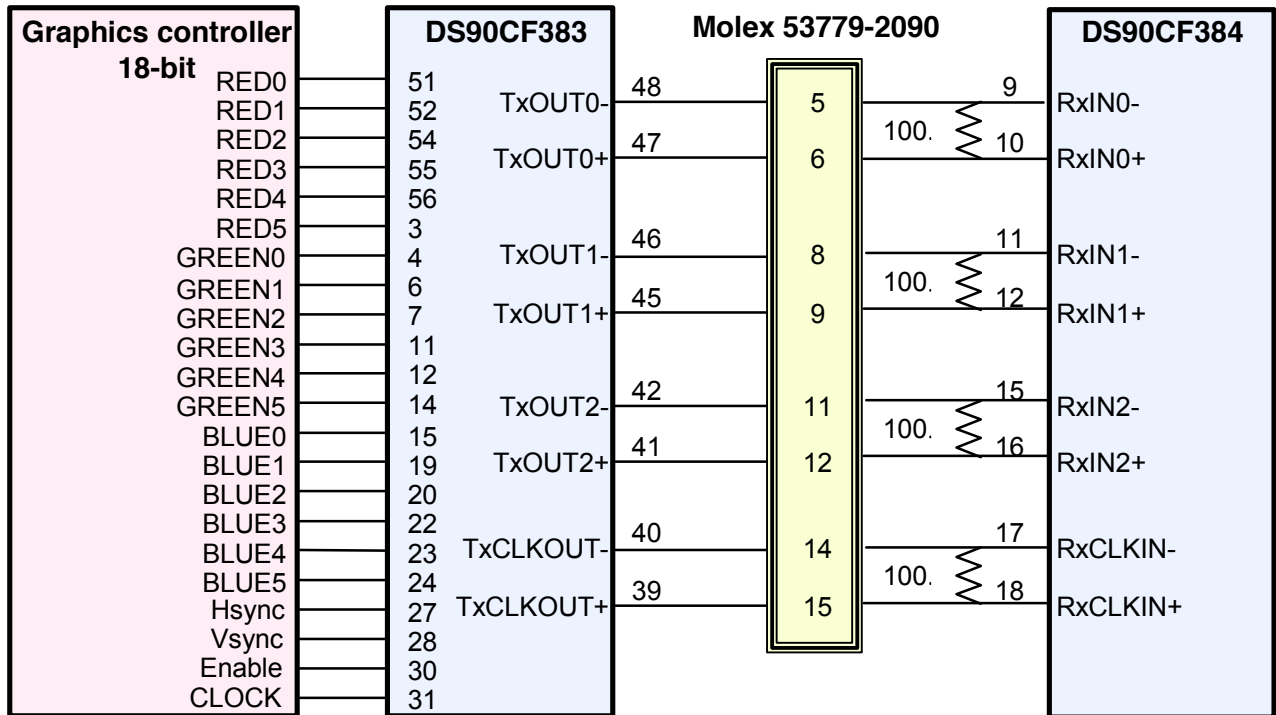
5.1. Input Signal & Power (LVDS Connector : Molex 53779-2090,  
Matching Connector : Molex FPC Type)

PIN NO	SYMBOL	FUNCTION	POLARITY	REMARK
1	VDD1	POWER SUPPLY +3.3V		
2	VDD2	POWER SUPPLY +3.3V		
3	GND1	GROUND		
4	GND2	GROUND		
5	RxIN0-	LVDS Differential Data INPUT	Negative	R0~R5 G0
6	RxIN0+	LVDS Differential Data INPUT	Positive	
7	GND3	GROUND		
8	RxIN1-	LVDS Differential Data INPUT	Negative	G1~G5 B0~B1
9	RxIN1+	LVDS Differential Data INPUT	Positive	
10	GND4	GROUND		
11	RxIN2-	LVDS Differential Data INPUT	Negative	B2~B5,DE Hsync,Vsync
12	RxIN2+	LVDS Differential Data INPUT	Positive	
13	GND5	GROUND		
14	RxCLKIN-	LVDS Differential Data INPUT	Negative	
15	RxCLKIN+	LVDS Differential Data INPUT	Positive	
16	GND6	GROUND		
17	NC	No Connection		
18	NC	No Connection		
19	GND7	GROUND		
20	GND8	GROUND		

5.2 LVDS Transmitter : DS90CF383 (National Semiconductor) or Compatible

Pin No.	Name	RGB Signal	Pin No.	Name	RGB Signal
51	TxIN0	R0	14	TxIN14	G5
52	TxIN1	R1	15	TxIN15	B0
54	TxIN2	R2	19	TxIN18	B1
55	TxIN3	R3	20	TxIN19	B2
56	TxIN4	R4	22	TxIN20	B3
3	TxIN6	R5	23	TxIN21	B4
4	TxIN7	G0	24	TxIN22	B5
6	TxIN8	G1	27	TxIN24	Hsync
7	TxIN9	G2	28	TxIN25	Vsync
11	TxIN12	G3	30	TxIN26	DE
12	TxIN13	G4	31	TxCLKIN	Clock

**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(BHR-03VS-01)

Matching Connector : JST(SM03B-BHS-1)

Pin No.	SYMBOL	COLOR	FUNCTION
1	HOT	PINK	High Voltage
2	N.C.	-	No Connector
3	COLD	WHITE	GROUND

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

Preliminary

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
BASIC COLOR	BLACK	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	-
	GREEN	0	0	0	0	0	0	1	1	1	1	1	1	0	0	0	0	0	-
	CYAN	0	0	0	0	0	0	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	-
	MAGENTA	1	1	1	1	1	1	0	0	0	0	0	0	1	1	1	1	1	-
	YELLOW	1	1	1	1	1	1	1	1	1	1	1	1	0	0	0	0	0	-
	WHITE	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	R0
	DARK 1.	1	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	R2
		: : : : : : : : : : : : : : : : : :	R3~R60																
	: : : : : : : : : : : : : : : : : :																		
	1. LIGHT	1	0	1	1	1	1	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	R62
	RED	1	1	1	1	1	1	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	G0
	DARK 1.	0	0	0	0	0	0	1	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	G2
		: : : : : : : : : : : : : : : : : :	G3~G60																
	: : : : : : : : : : : : : : : : : :																		
	1. LIGHT	0	0	0	0	0	0	1	0	1	1	1	1	0	0	0	0	0	G61
		0	0	0	0	0	0	0	1	1	1	1	1	0	0	0	0	0	G62
	GREEN	0	0	0	0	0	0	1	1	1	1	1	1	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	B0
	DARK 1.	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	B1
		0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	B2
		: : : : : : : : : : : : : : : : : :	B3~B60																
	: : : : : : : : : : : : : : : : : :																		
	1. LIGHT	0	0	0	0	0	0	0	0	0	0	0	0	1	0	1	1	1	B61
		0	0	0	0	0	0	0	0	0	0	0	0	0	1	1	1	1	B62
	BLUE	0	0	0	0	0	0	0	0	0	0	0	0	1	1	1	1	1	B63

**Note**

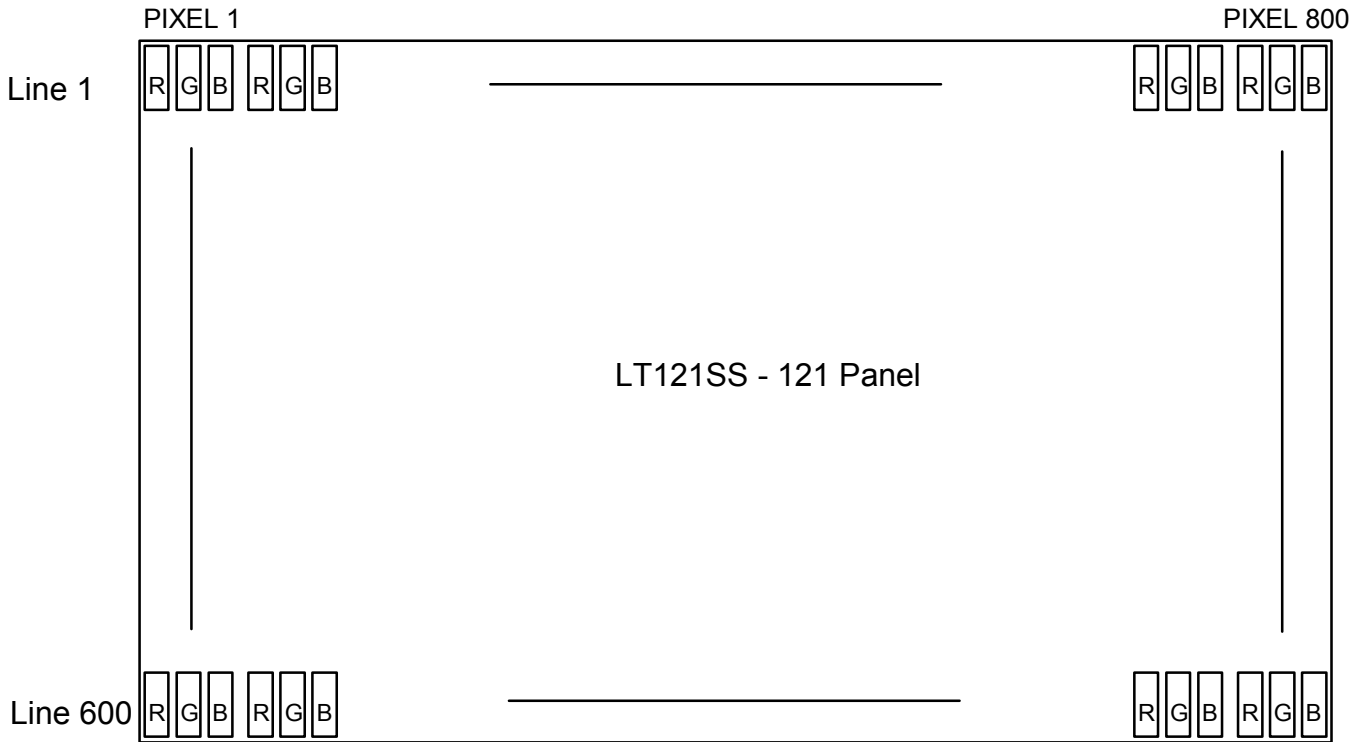
(1) Definition of Gray :

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

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

5.5 PIXEL FORMAT

Preliminary



## 6. INTERFACE TIMING

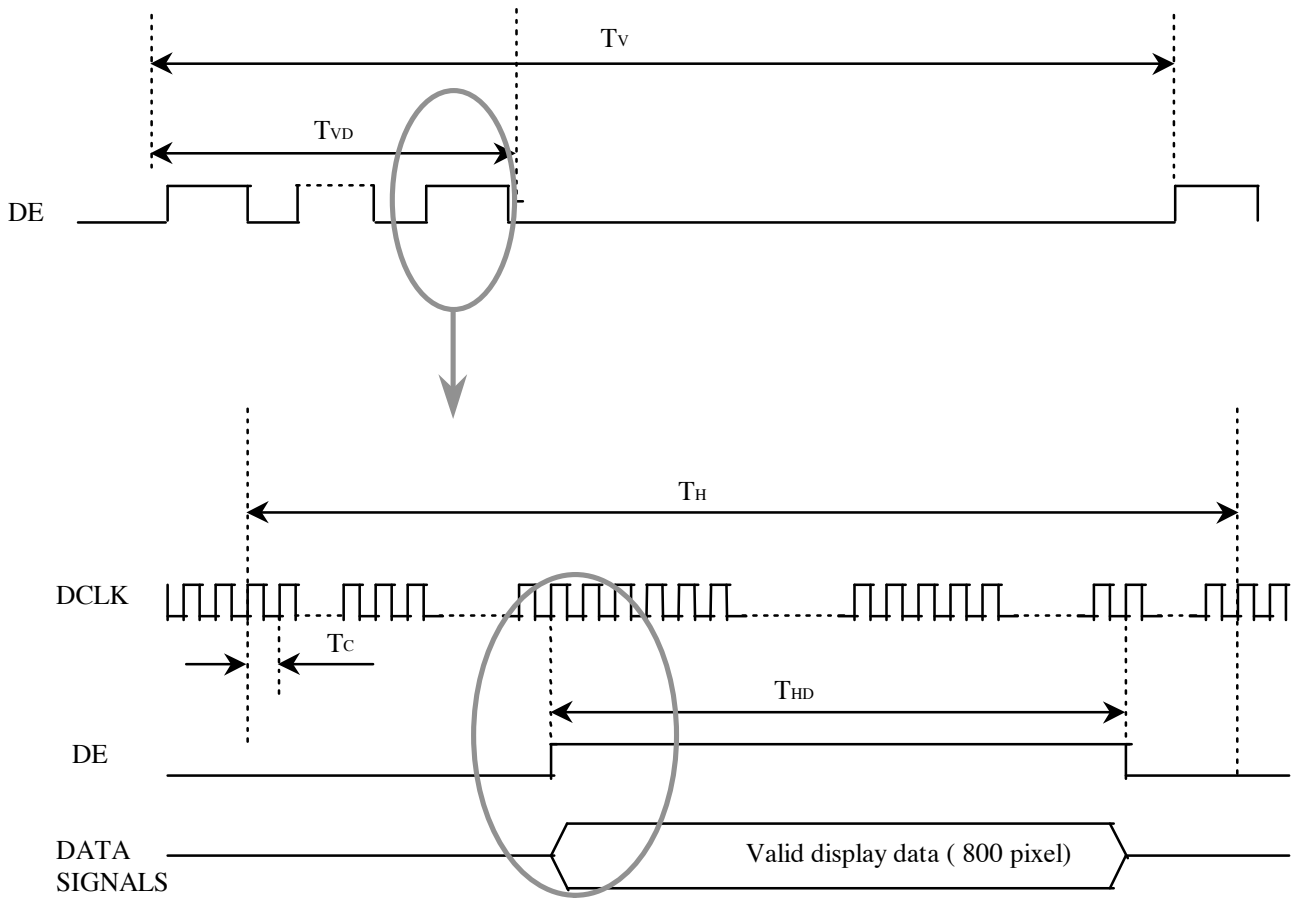
### 6.1 Timing Parameters (DE only mode)

SIGNAL	ITEM	Symbol	Min.	Typ.	Max.	Unit	Note
CLOCK	Frequency	$1/T_c$	38	40	42.	Mhz	
	High Time	$T_{CH}$	5	-	-	ns	
	Low Time	$T_{CL}$	5	-	-	ns	
DATA	Setup Time	$T_{DS}$	5	-	-	ns	
	Hold Time	$T_{DH}$	5	-	-	ns	
DATA Enable	Setup Time	$T_{ES}$	5	-	-	ns	
Frame Frequency	Cycle	$T_v$	-	16.67	-	msec	
Vertical Active Display Term	Display Period	$T_{VD}$	600	600	600	lines	
One Line Scanning Term	Cycle	$T_H$	1024	1056	1056	clocks	
Horizontal Active Display Term	Display Period	$T_{HD}$	800	800	800	clocks	

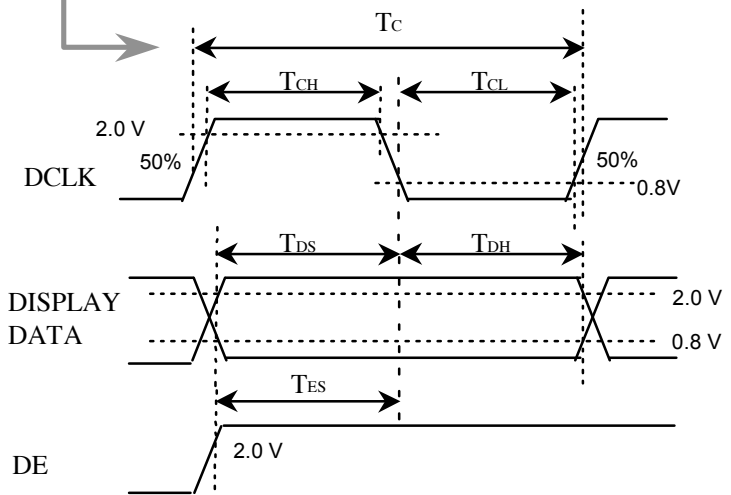
Note (1) When the VGA controller sets DE only mode, Hsync and Vsync should be set low logic level or ground.

(2) The duration of DE [DTMG] signal must be longer than 1 clock period at every horizontal sync. period

6.2 Timing diagrams of interface signal

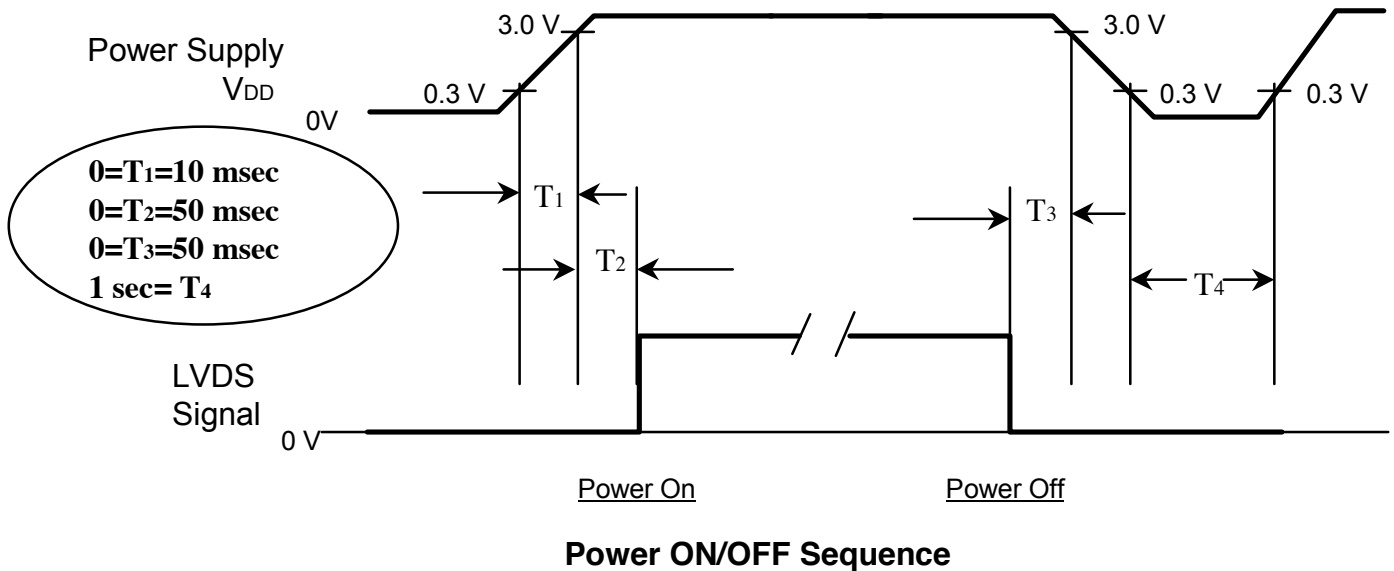


- Signal Transition Timing



### 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.

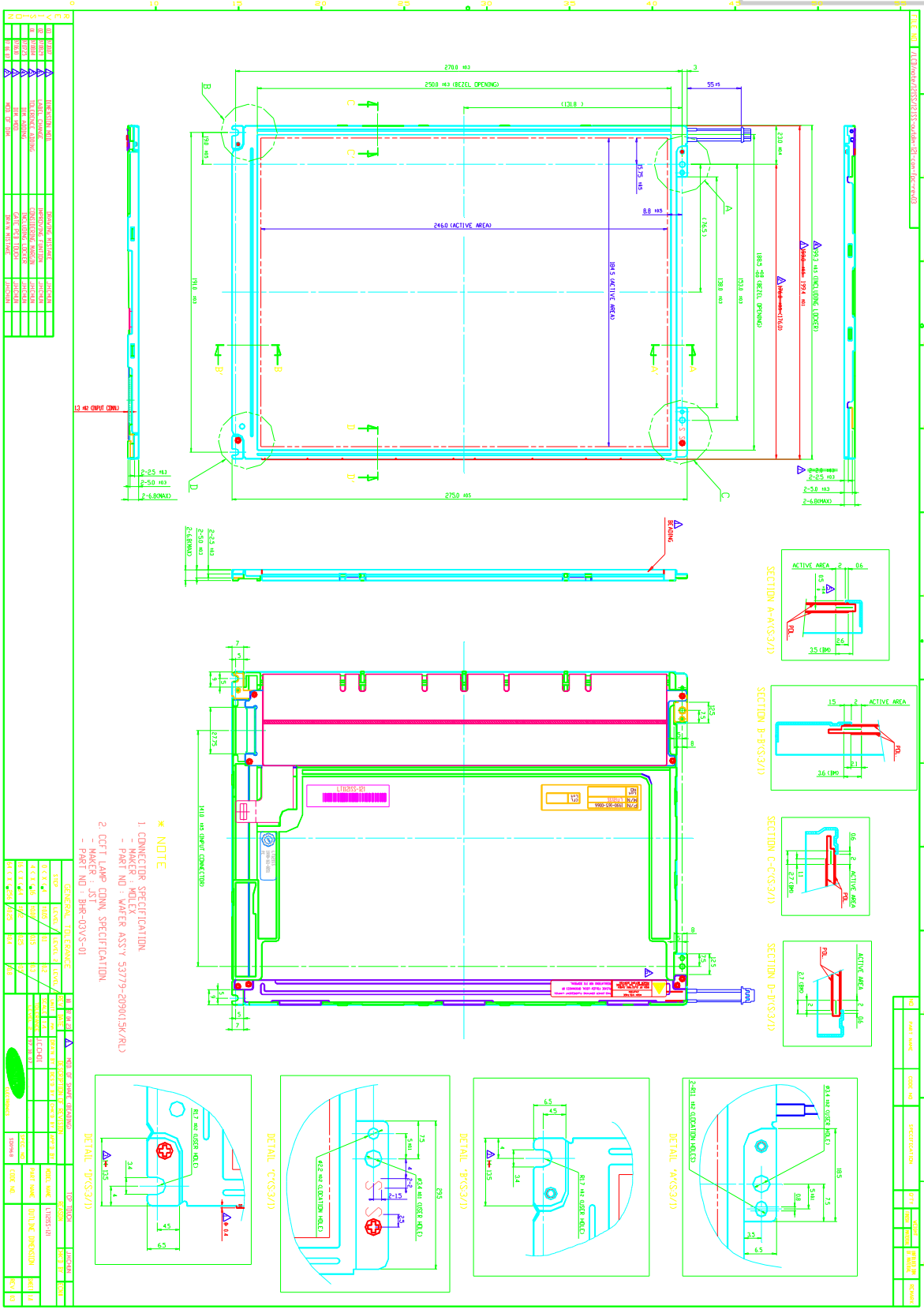


**NOTE.**

- (1) The supply voltage of the external system for the module input should be the same as the definition of  $V_{cc}$ .
- (2) Apply the lamp voltage within the LCD operation range. When the backlight turns on before the LCD operation or the LCD turns off before the backlight turns off, the display may momentarily become white.
- (3) In case of  $V_{cc} = \text{off level}$ , please keep the level of input signals on the low or keep a high impedance.
- (4)  $T_4$  should be measured after the module has been fully discharged between power off and on period.

# 7. Outline Dimension

Preliminary



**\* NOTE**  
 1. CONNECTOR SPECIFICATION  
 - MAKER : MOLEX  
 - PART NO : WAFER ASSY 59779-09001SK/R/D  
 2. COIT LAMP CONN. SPECIFICATION  
 - PART NO : BR-03VS-01

REV.	DESCRIPTION	DATE	BY	CHKD.	APP'D.
1	ISSUED FOR QUOTE				
2	REVISED DIMENSIONS				
3	REVISED DIMENSIONS				
4	REVISED DIMENSIONS				
5	REVISED DIMENSIONS				
6	REVISED DIMENSIONS				
7	REVISED DIMENSIONS				
8	REVISED DIMENSIONS				
9	REVISED DIMENSIONS				
10	REVISED DIMENSIONS				
11	REVISED DIMENSIONS				
12	REVISED DIMENSIONS				
13	REVISED DIMENSIONS				
14	REVISED DIMENSIONS				
15	REVISED DIMENSIONS				
16	REVISED DIMENSIONS				
17	REVISED DIMENSIONS				
18	REVISED DIMENSIONS				
19	REVISED DIMENSIONS				
20	REVISED DIMENSIONS				

## 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 improper operation or damage to the module and CCFL backlight.
- (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. Otherwise, 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 permanently damage 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) The cable for lamp(CCFT) shall not be pull or held.
- (n) Protection film for polarizer on the module shall be slowly feeled off just before use so that the electrostatic charge can be minimized.
- (o) 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 is 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 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.