



ELECTRONICS

APPROVAL

TO :

DATE :

SAMSUNG TFT-LCD
MODEL NO. : LT133X1-106

NOTE :

Any Modification of Spec is not allowed without SEC' permission

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PREPARED BY : LCD Application Engineering Team

SAMSUNG ELECTRONICS CO., LTD.

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Revision History

Date	Rev.No.	Page	Summary		
Aug.7. 1997	000		LT133X1-106 model was First issued.		
Oct.14. 1997	001	4	Surface treatment (2H to 3H)		
		5	Module weight (600g to 610g) 1.1 Add Note (4) Storage temperature (-25 to -20 degree C)		
		6	Remove lamp voltage & Add lamp frequency.		
		7	Add optical characteristic chart		
		11	Vsync & Hsync frequency Power supply current (Max) (460 to 480 Ma)		
		13	Add note (5) -- inverter startup time. Change TBD to actual values.		
		14	Add figure of reflector.		
		20	Add actual values in the chart.		
		Nov.17. 1997	002	13	Changed lamp start-up time from 1s to 100ms
				13	Changed lamp start-up voltage

GENERAL DESCRIPTION

DESCRIPTION

LT133X1-106 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 13.3" contains 1024 x 768 pixels and can display up to 262,144 colors. 6 o'clock direction is the optimum viewing angle.

FEATURES

- Thin and light weight
- High contrast ratio, high aperture structure, Wide viewing angle
- High-speed response
- XGA (1024x768 pixels) resolution
- Low power consumption
- Single CCFL(Cold Cathode Fluorescent Lamp)
- DE(Data enable) only mode
- 5V LVDS Interface with 2 pixels/ clock

APPLICATIONS

- Note 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 Specifications

ITEM	SPECIFICATION	UNIT	NOTE
Display area	270.3(H) x 202.752(V) (13.3 " diagonal)	mm	
Driver element	a-si TFT active matrix		
Display colors	262,144	colors	
Number of pixel	1024 x 768	pixels	
Pixel arrangement	RGB vertical stripe		
Pixel pitch	0.264(H) x 0.264(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)	297.3	297.8	298.3	mm
	Vertical (V)	213	213.5	214	mm
	Thickness (T)	7.5	8.0	8.5	mm
Weight		-	-	610	g

1. ABSOLUTE MAXIMUM RATINGS

1.1 ABSOLUTE RATINGS OF ENVIRONMENT

ITEM	SYMBOL	MIN.	MAX.	UNIT	NOTE
Storage temperate	T_{STG}	-20	60	$^{\circ}C$	(1)
Operating temperate (Ambient)	T_{OPR}	0	50	$^{\circ}C$	(1)lamp current 4mA
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.

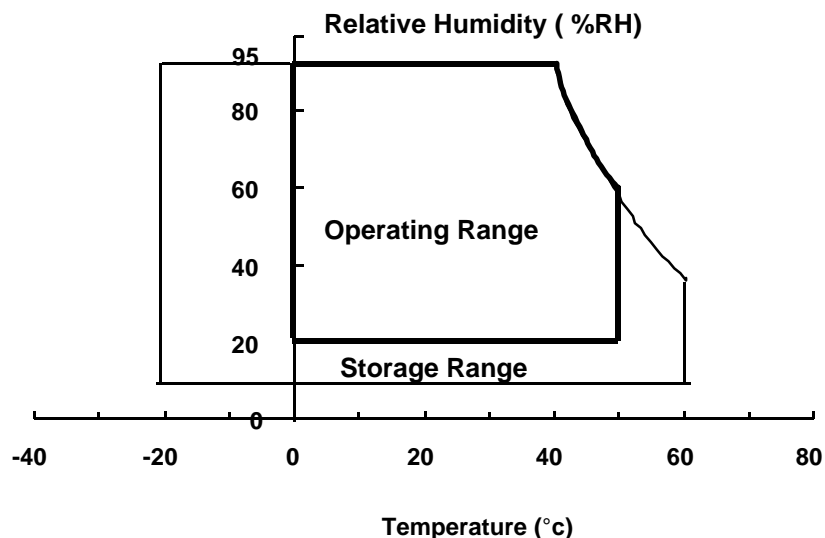
95 % RH Max. ($40^{\circ}C < T_a$)

Maximum wet - bulb temperature at $39^{\circ}C$ or less. ($T_a > 40^{\circ}C$) No condensation.

(2) 6ms, (half) sine wave, one time for $\pm X, \pm Y, \pm Z$.

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

(GND = 0 V)

ITEM	SYMBOL	MIN.	MAX.	UNIT	NOTE
Power Supply Voltage	VDD	GND -0.3	6.0	V	(1)
Logic Input Voltage	V _{IN}	GND -0.3	VDD+0.3	V	(1)

NOTE (1) Within Ta (25 ± 2 °C)

(2) BACK-LIGHT UNIT

ITEM	SYMBOL	MIN.	MAX.	UNIT.	NOTE
Lamp Current	I _L	2.0	6.0	mArms	(1)
Lamp frequency	F _L	30	60	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

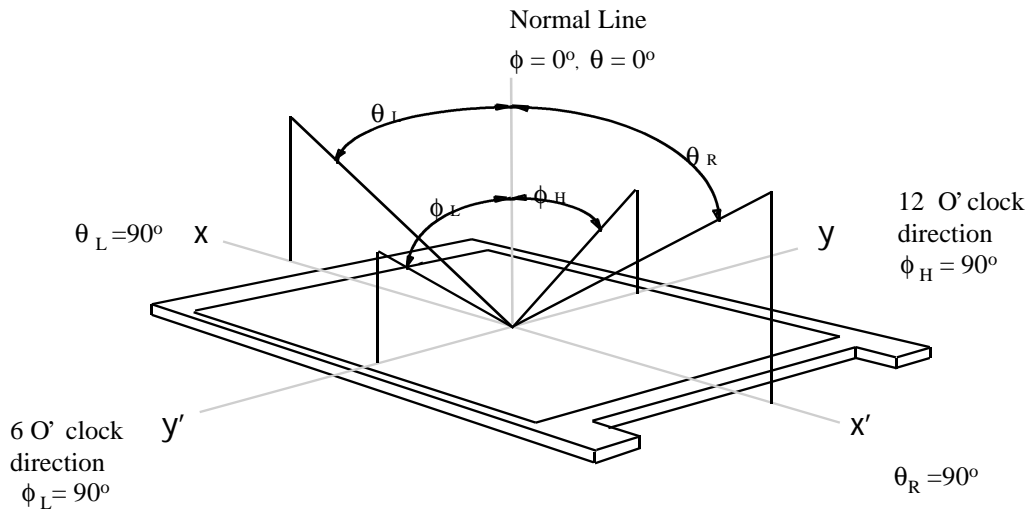
The following items are measured under stable conditions. The optical characteristics shall be measured in the dark room or equivalent state with the method shown in Note (5).

Measuring equipment : TOPCON BM-5A,

*, Ta = 25 °C ± 2°C , Vdd= 5.0V, fv= 60Hz, fdCLK=32.5MHz

ITEM		SYMBOL	CONDITION	MIN.	TYP.	MAX.	UNIT	
Contrast Ratio		CR	$\phi = 0$ $\theta = 0$ Viewing Normal Angle	120	-	-		(1),(2),(5)
Response Time at 25 °C	Rise	TR		-	30	50	msec	(1), (3)
	Fall	TF		-	50	70		
Average Luminance of White (5 Points)		YL,AVE		50	70	-	cd/m ²	(1), (4), (5)
Color Chromaticity (CIE)	Red	R _x		0.553	0.583	0.613		(1),(5)
		R _y		0.320	0.350	0.380		
	Green	G _x		0.290	0.320	0.350		
		G _y		0.503	0.533	0.563		
	Blue	B _x		0.125	0.155	0.185		
		B _y		0.108	0.138	0.168		
	White	W _x	0.296	0.326	0.356			
		W _y	0.300	0.330	0.360			
Viewing Angle	Hor.	θ_L	CR ≥ 10	40	-	-	Degrees	
		θ_R		40	-	-		
	Ver.	ϕ_H		15	-	-		
		ϕ_L		35	-	-		
13 Points White Variation		L				2.0		(6)

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

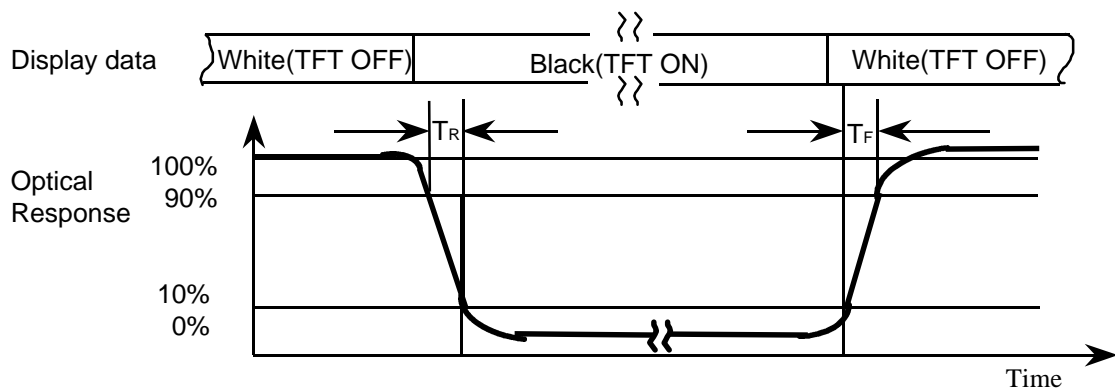


Note 2) Definition of Contrast Ratio (CR) :

$$CR = \frac{CR1 + CR2 + CR3 + CR4 + CR5}{5}$$

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

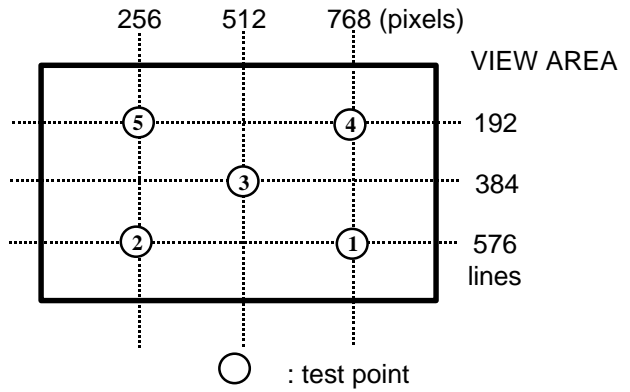
Note 3) Definition of Response time :



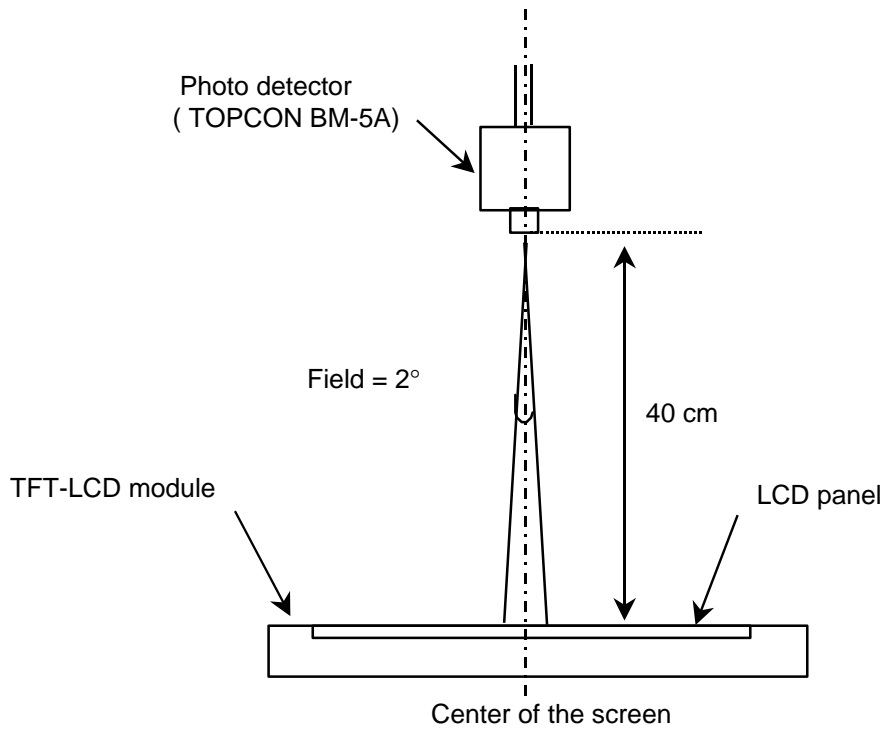
Note 4) Definition of Average Luminance of White : measure the luminance of white at 5 points.

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

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



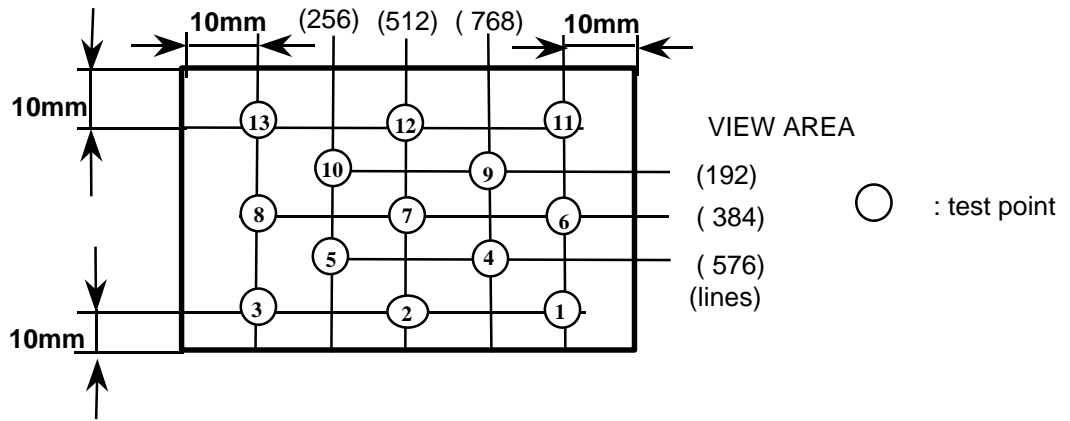
Note 5) After stabilizing and leaving the panel alone at a given temperature for 30 min. , the measurement should be executed. Measurement should be executed in a stable, windless, and dark room. 30 min after lighting the back-light. This should be measured in the center of screen.
 Lamp current : 4.0mA
 Environment condition : $T_a = 25 \pm 2 \text{ } ^\circ\text{C}$



Optical characteristics measurement setup

Note 6) Definition of 13 points white variation (L)

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



3. ELECTRICAL CHARACTERISTICS

3.1 TFT LCD MODULE

Ta=25°C ± 2 °C

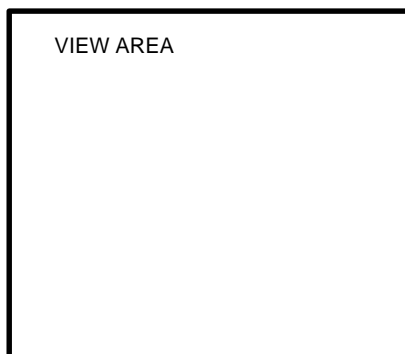
ITEM	SYMBOL	MIN	TYP	MAX	UNIT	NOTE	
Power Supply Voltage	V _{DD}	4.5	5.0	5.5	V		
Input Signal Range	V _{in}	0	-	2.4	V	LVDS Signal	
Differential Input Threshold Voltage	High	V _{th}	-	-	+100	mV	V _{cm} =1.2V
	Low	V _{tl}	-100	-	-	mV	
Input Current	High	I _h	-	-	± 10	μA	V _{in} =2.4V V _{DD} =5.5V
	Low	I _{lL}	-	-	± 10	μA	V _{in} =0V V _{DD} =5.5V
Termination Resistance	R _t	-	100	-			
Vsync Frequency	f _v	55	60	65	Hz		
Hsync Frequency	f _H	45	48.2	51	kHz		
Main Frequency	f _{DCLK}	30	32.5	35	MHz		
Rush Current	I _{RUSH}	-	-	1.5	A	(4)	
Power Supply Current	White	I _{CC}	-	280	-	mA	(2)(3) *a
	Mosaic		-	330	-	mA	(2)(3) *b
	V.Stripe		-	400	480	mA	(2)(3) *c

Note (1) Display data pins and timing signal pins are subjected.(GND=0V)

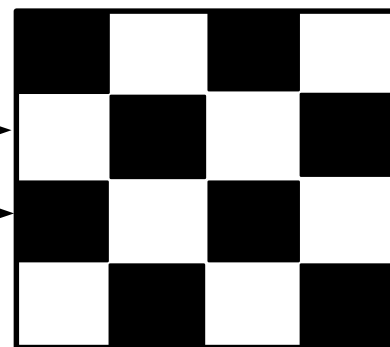
(2) f_v=60Hz, f_{DCLK} =32.5MHZ, V_{DD} = 5.0V, DC Current.

(3) Power dissipation check pattern.

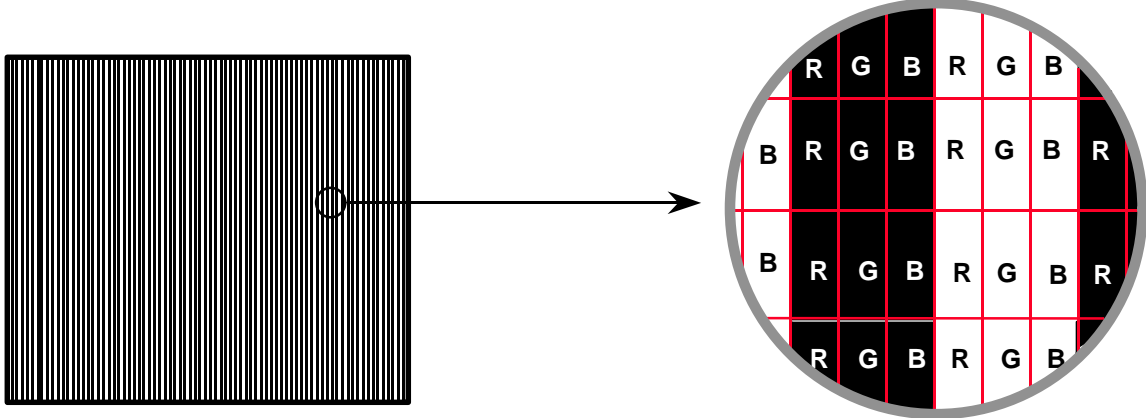
*a) White Pattern



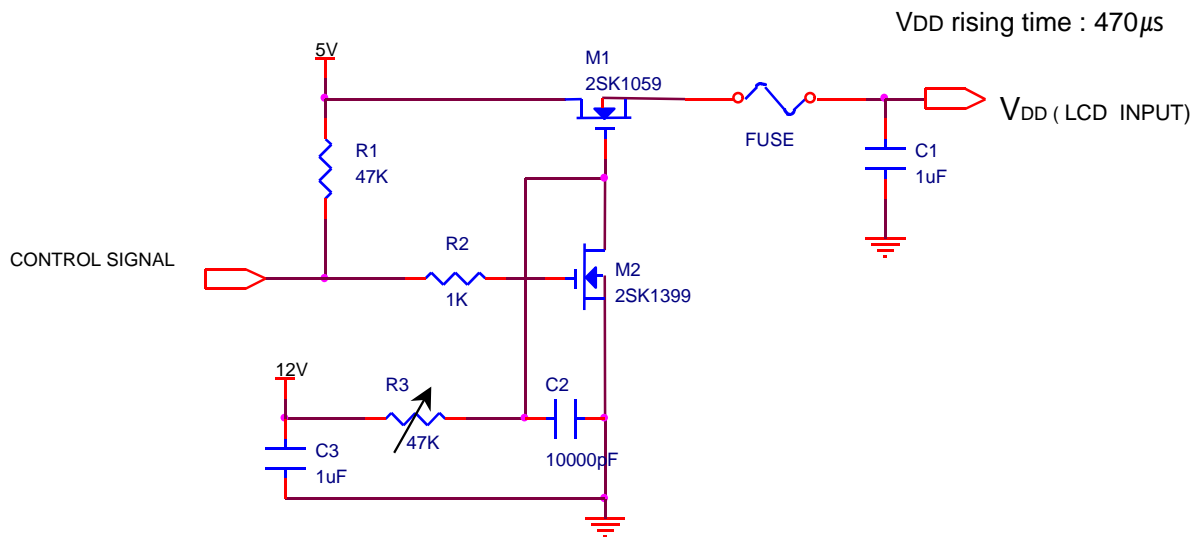
*b) Mosaic Pattern



*c) Vertical stripe pattern



(4) Measurement Conditions



3.2 BACK-LIGHT UNIT

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

INVERTER : SEMCO, SIC-130

LAMP : Harison,HMBS22JD38E205N/AXS. (BK)

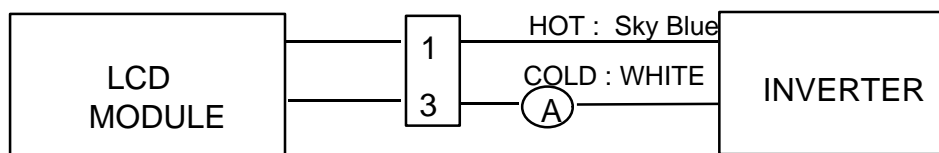
Ta=25°C ± 2 °C

ITEM	SYMB	MIN	TYP	MAX	UNIT	NOTE
Lamp Current	I _L	2	4	6	mArms	(1)
Lamp Voltage	V _L	-	525	-	V _{rms}	I _L =4mA
		-	475	-	V _{rms}	I _L =6mA
Frequency	f _L	40	-	60	kHz	(2)
Power Consumption	P _L	-	2.10	-	W	(3) I _L =4mA
Operating Life Time	H _r	10,000	-	-	Hour	(4)
Startup Voltage	V _s	-	-	1100 (25)	V _{rms}	(5)
				1300 (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.



No 3 Pin is V_{Low}.

SEMCO,SIC-130

Switching Frequency : 40 ~ 60 KHz

(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 × V_L to calculate.

(4) Life time (Hr) of a lamp can be is defined as the time in which it continues to operate under the condition Ta = 25 and I_L = 4.0 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.

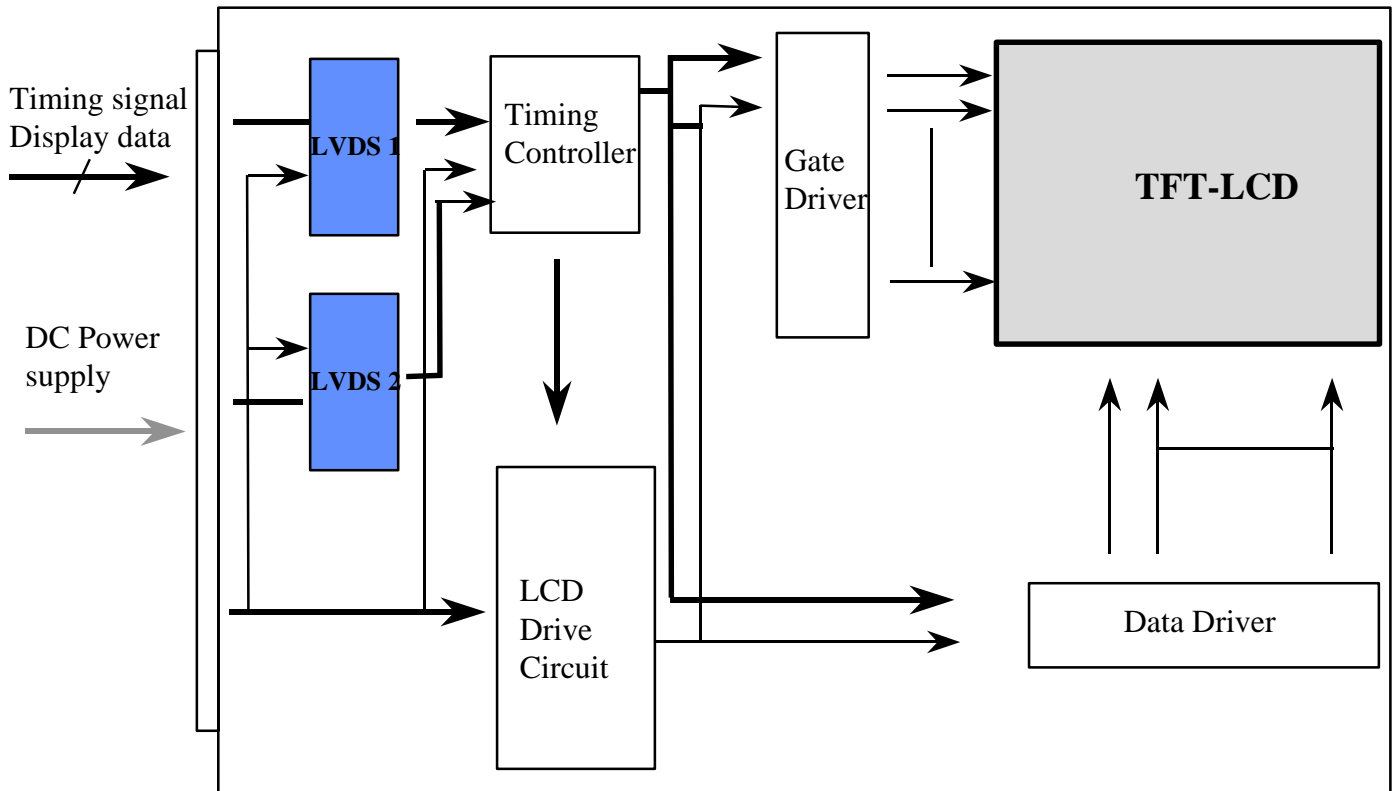
(Effective ignition length is defined as an area that has less than 70% brightness compared to the brightness in the center point.)

(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.

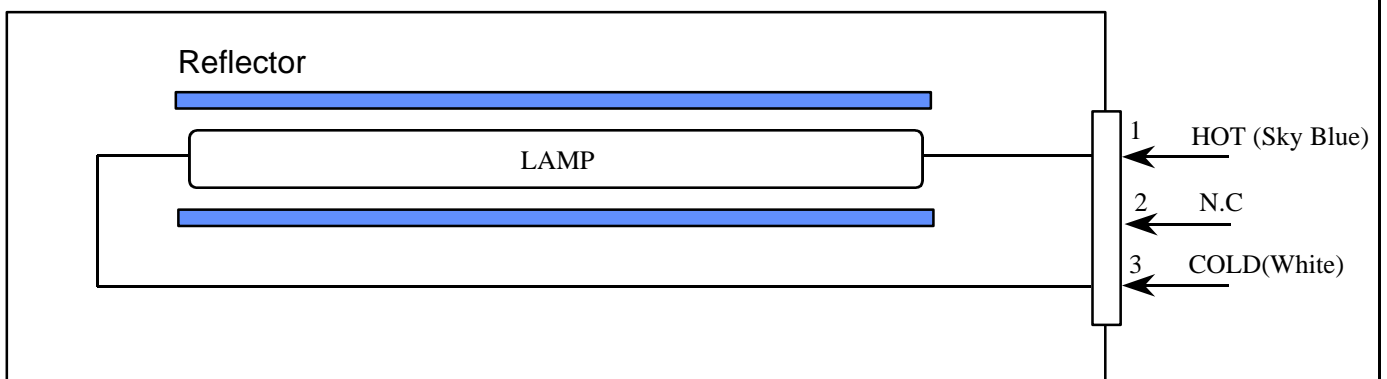
4. BLOCK DIAGRAM

4.1 TFT LCD MODULE

Connector : JAE FI-SEB-20P-HF-E1500



4.2 BACK-LIGHT UNIT



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

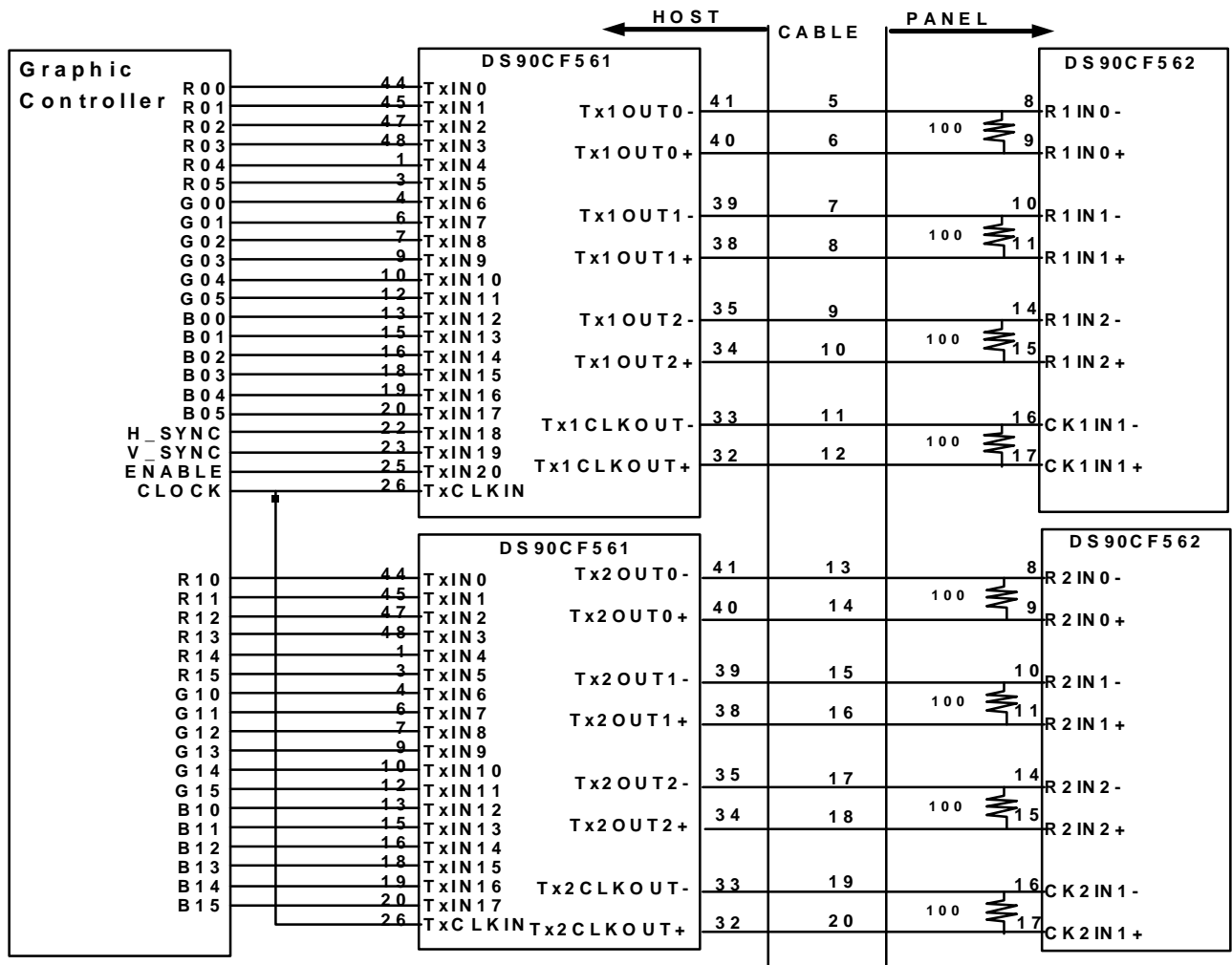
5. INPUT TERMINAL PIN ASSIGNMENT

5.1. Input Signal & Power (LVDS, Connector : JAE FI-SEB-20P-HF-E1500)

Mating Connector : FI-SE20M

Pin NO.	Symbol	Function	Polarity	Output pin # (Transmitter)	Remark
1	V _{DD}	Power Supply +5V			
2	V _{DD}	Power Supply +5V			
3	GND	Power Ground			
4	GND	Power Ground			
5	R1IN 0-	Odd Receiver Signal(-)	Negative	PIN # 41	
6	R1IN 0+	Odd Receiver Signal(+)	Positive	PIN #40	
7	R1IN 1-	Odd Receiver Signal(-)	Negative	PIN #39	
8	R1IN 1+	Odd Receiver Signal(+)	Positive	PIN #38	
9	R1IN 2-	Odd Receiver Signal(-)	Negative	PIN #35	
10	R1IN 2+	Odd Receiver Signal(+)	Positive	PIN #34	
11	CK1IN -	Clock Signal(-)	Negative	PIN #33	
12	CK1IN +	Clock Signal(+)	Positive	PIN #32	
13	R2IN 0-	Even Receiver Signal(-)	Negative	PIN #41	
14	R2IN0+	Even Receiver Signal(+)	Positive	PIN #40	
15	R2IN 1-	Even Receiver Signal(-)	Negative	PIN #39	
16	R2IN 1+	Even Receiver Signal(+)	Positive	PIN #38	
17	R2IN 2-	Even Receiver Signal(-)	Negative	PIN #35	
18	R2IN 2+	Even Receiver Signal(+)	Positive	PIN #34	
19	CK2IN -	Even Clock Signal(-)	Negative	PIN #33	
20	CK2IN+	Even Clock Signal(+)	Positive	PIN #32	

5.3 LVDS Interface



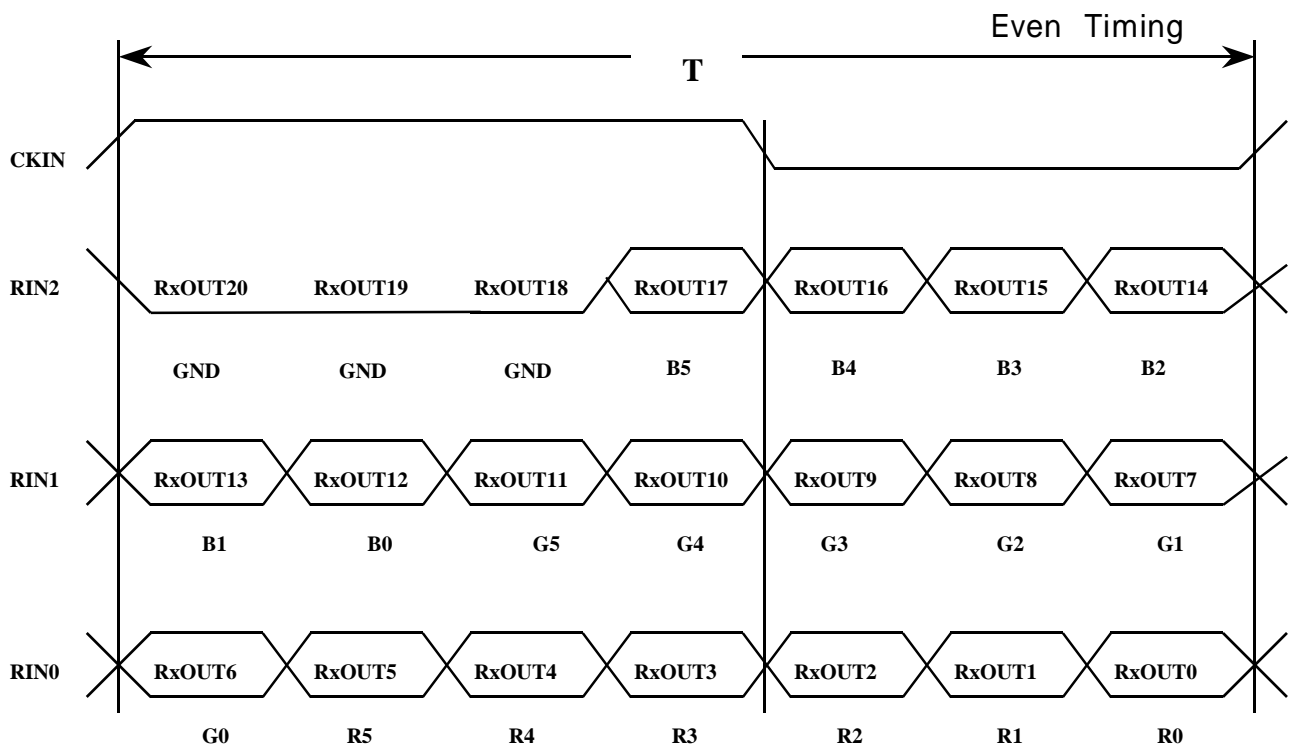
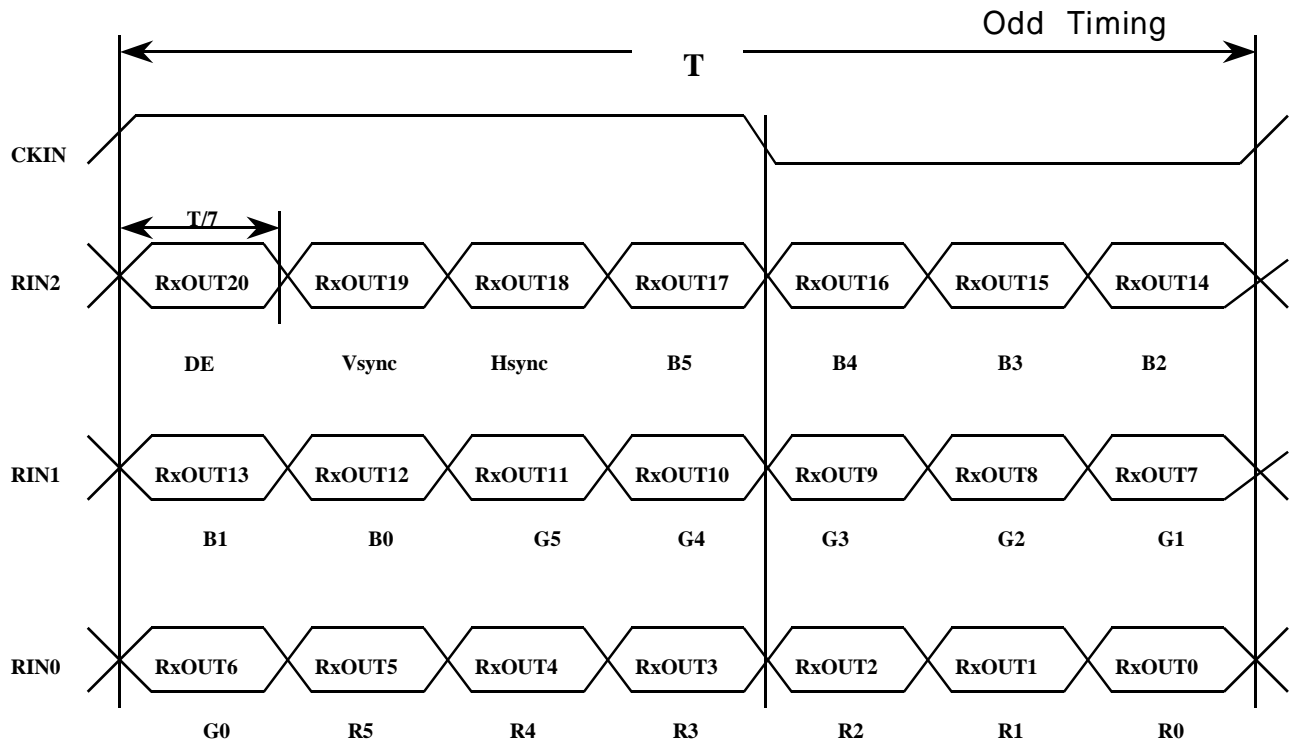
Note : Use JAE FI-SEB-20P-HF-E1500 Connector on the TFT module side

5.3 BACK LIGHT UNIT

Using Connector : JST BHR - 03VS -1
Mating Connector : SM02(8.0)B-BHS(JST)

Pin NO.	Symbol	Color	Function
1	HOT	Sky Blue	High Voltage
2	N.C.	-	No Connection
3	COLD	White	Ground

5.4 Timing Diagrams of LVDS For Transmitting



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	-	
	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	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	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	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

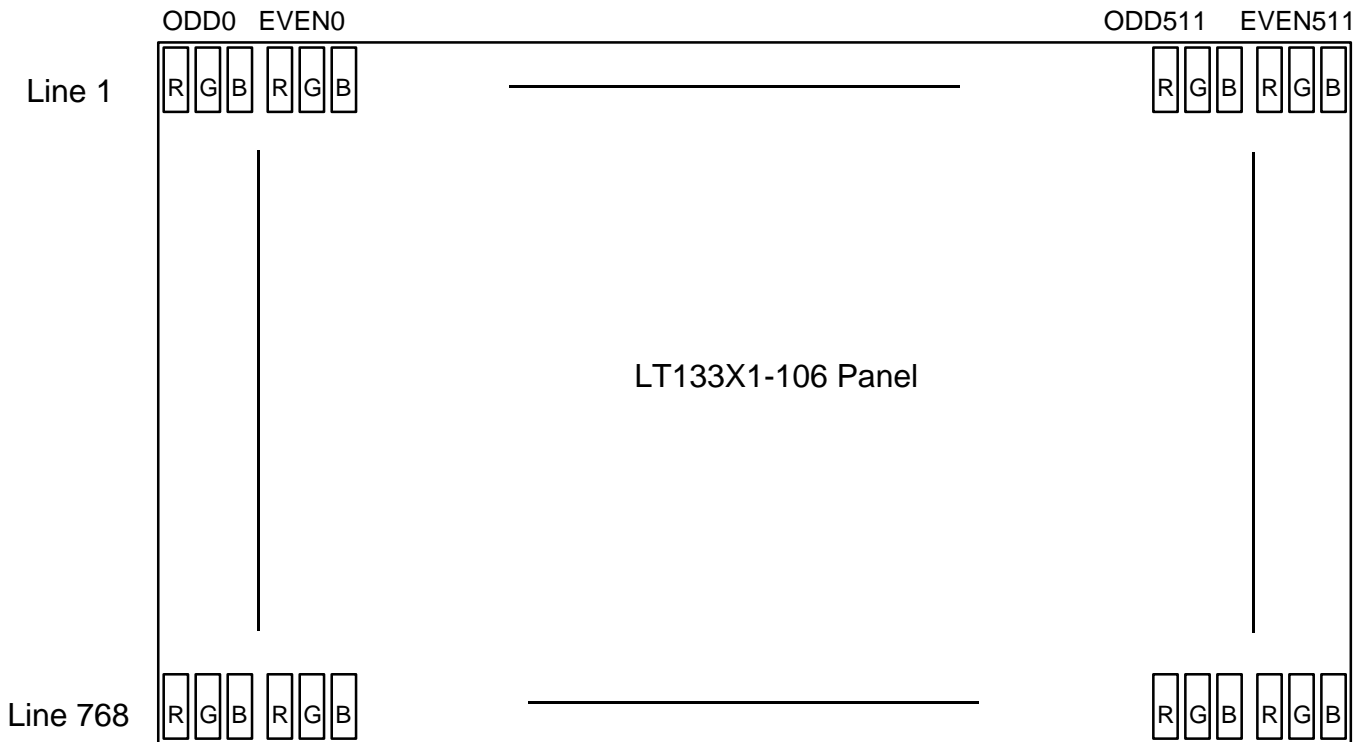
Note

(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

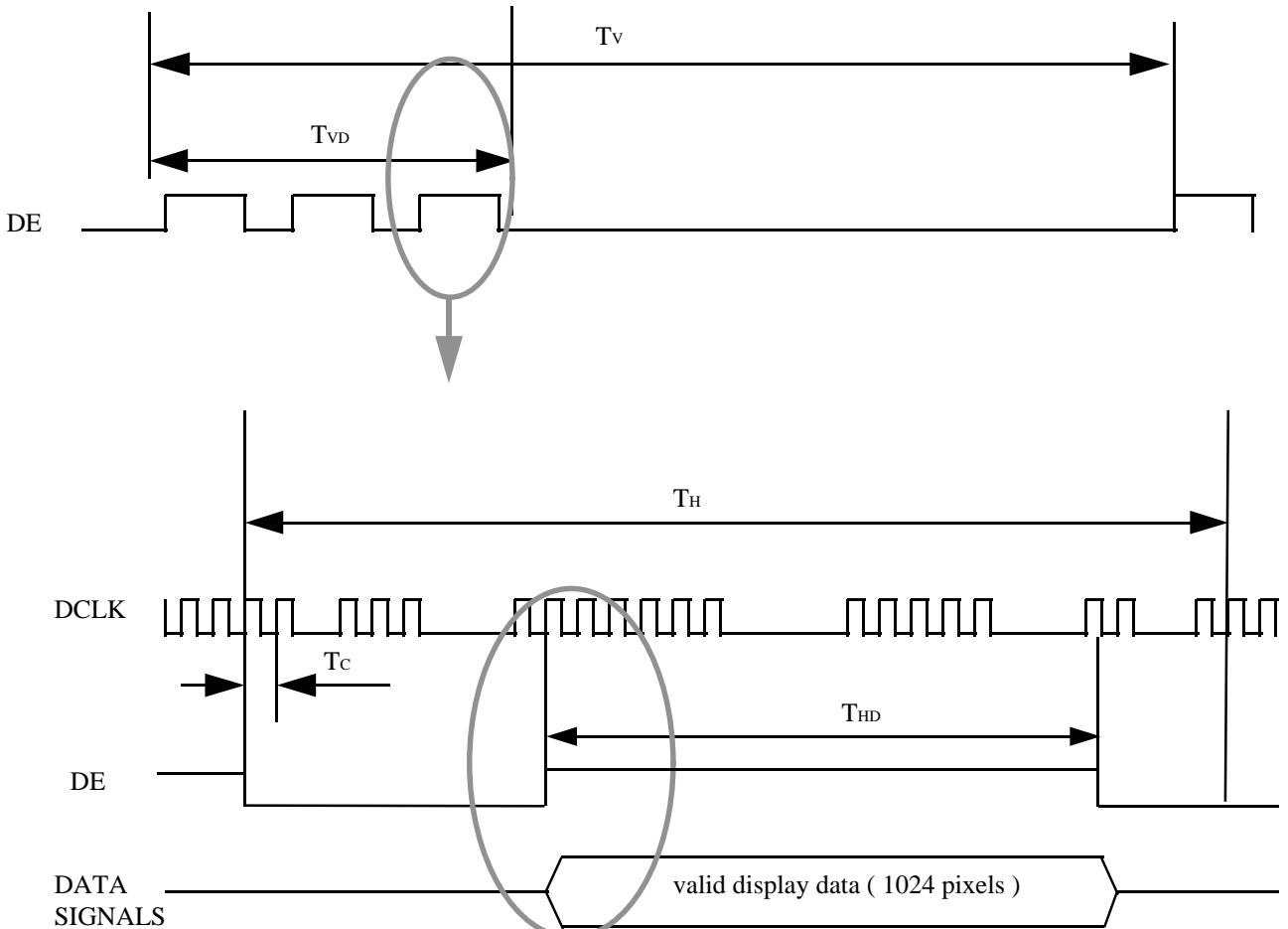
6.1 Timing Parameters

Signal	Item	Symbol	MIN.	TYP.	MAX.	Unit	Note
Clock	Frequency	$1 / T_c$	30	32.5	35	MHz	
	High Time	T_{CH}	4	-	-	nsec	
	Low Time	T_{CL}	4	-	-	nsec	
Data	Setup Time	T_{DS}	4	-	-	nsec	
	Hold Time	T_{DH}	4	-	-	nsec	
Data Enable	Setup Time	T_{ES}	4	-	-	nsec	(1)
Frame Frequency	Cycle	T_v	772	806	900	Lines	
Vertical Active Display Term	Display Period	T_{VD}	768	768	768	Lines	
One Line Scanning Term	Cycle	T_H	612	670	700	Clock	(2)
Horizontal Active Display Term	Display Period	T_{HD}	512	512	512	Lines	

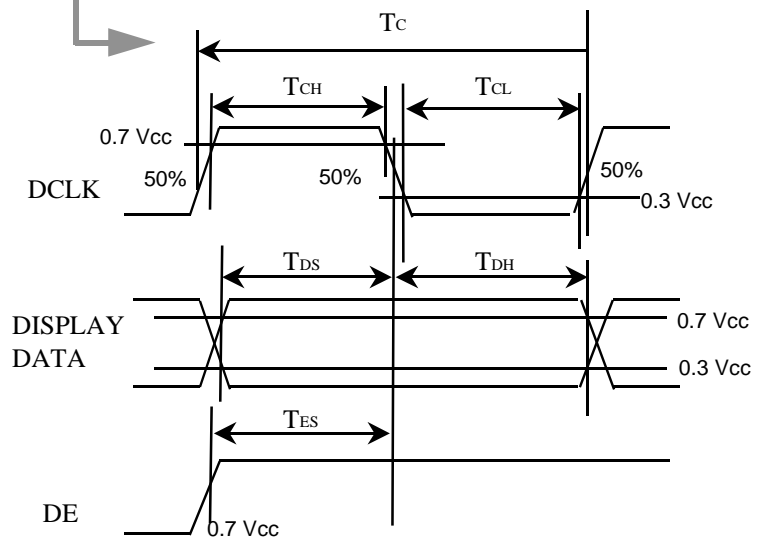
Note (1) When the VGA controller sets DE only mode, Hsync and Vsync should be set low logic level or ground.

(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

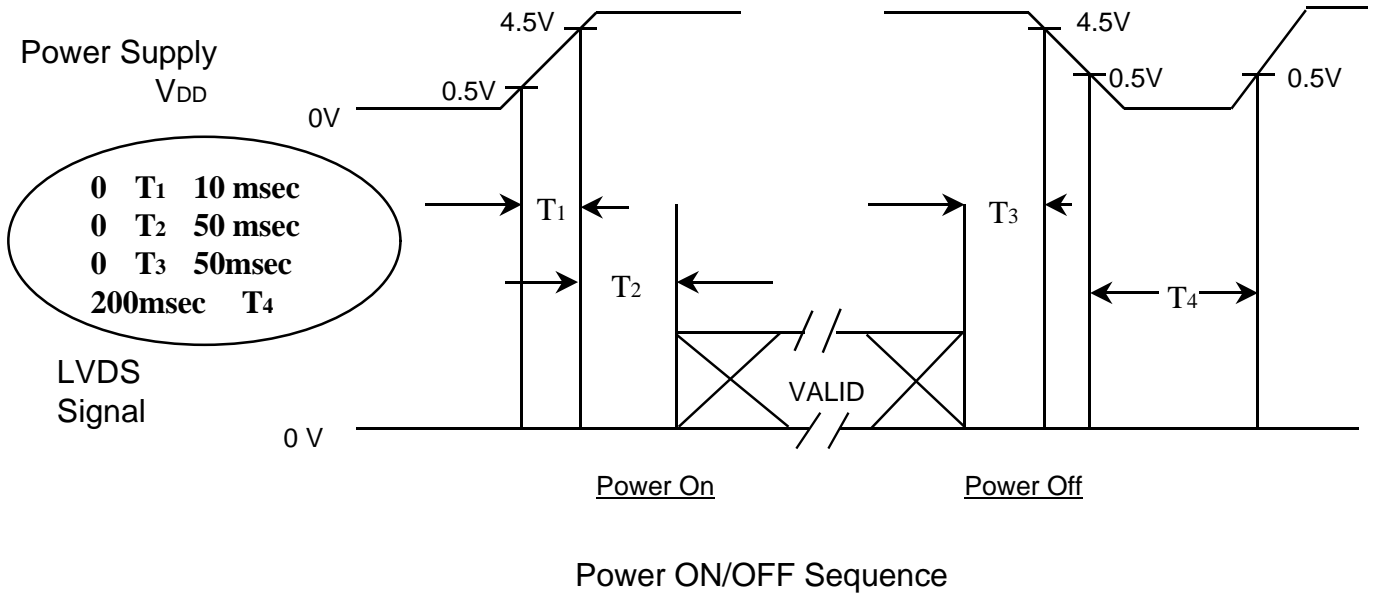


- Signal Transition Timing



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_{DD} .
- (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_{DD} = 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.
- (5) Interface signal shall not be kept at high impedance when the power is on.

7. Outline Dimension

Refer to the attached file.

8. GENERAL PRECAUTIONS

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 CCFT 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. 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 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.