SAMSUNG ELECTRONICS

Preliminary

TO :

DATE : Jan. 17. 2002

SAMSUNG TFT-LCD

MODEL NO. : LT133XB-122

APPROVED BY : _____

CHECKED BY : _____

Notes :

Any Modification of Spec is not allowed without SEC's permission.

PREPARED BY :

Technical Customer Service Team

SAMSUNG ELECTRONICS CO., LTD.

wise view™

CONTENTS

REVISION HISTORY

Preliminary

Date	Rev.No.	Page	Summary
Nov. 5.1997	000	All	LT133XB-122 model was First issued
Apr.16, 1998	001	All	Fixed the spec data sheet

GENERAL DESCRIPTION

DESCRIPTION

LT133XB-122 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 1024x 768 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
- XGA (1024x768) pixels resolution
- Low power consumption single CCFL(Cold Cathode Fluorescent Lamp)
- DE (Data enable) only mode.
- 3.3V LVDS Interface with 1 pixels / clock

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	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

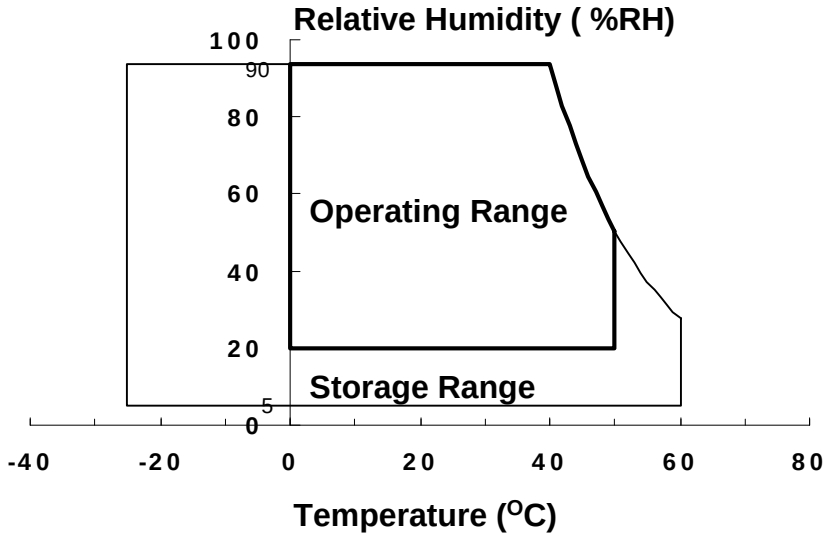
ITEM		MIN.	TYP.	MAX.	NOTE
Module size	Horizontal (H)	289.0	289.5	290.0	
	Vertical (V)	213.0	213.5	214.0	
	Depth (D)	-	-	8.5	
Weight				600g	

1. ABSOLUTE MAXIMUM RATINGS

1.1 ENVIRONMENTAL ABSOLUTE RATINGS

ITEM	SYMBOL	MIN.	MAX.	UNIT	NOTE
Storage temperate	T_{STG}	-20	60	°C	(1)
Operating temperate (Temperature of glass surface)	T_{OPR}	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.
Maximum wet - bulb temperature at 39 °C or less. (No condensation)
(2) 6ms, half sine wave, one time for ± X, ± Y, ± Z.
(3) 10 - 55 - 10 Hz, Sweep rate 2.5 min, 2hrs 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_{DD} =5.0 V, Vss=GND= 0V

ITEM	SYMBOL	MIN.	MAX.	UNIT	NOTE
Power Supply Voltage	V_{DD}	Vss -0.3	6.0	V	
Logic Input Voltage	V_{IN}	Vss -0.3	4.0	V	

Note 1) Within Ta = (25 ± 2 ºC)

(2) BACK-LIGHT UNIT

Ta = 25 ± 2 °C

ITEM	SYMBOL	MIN.	MAX.	UNIT	NOTE
Lamp Current	I_L	-	6.5	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 condition

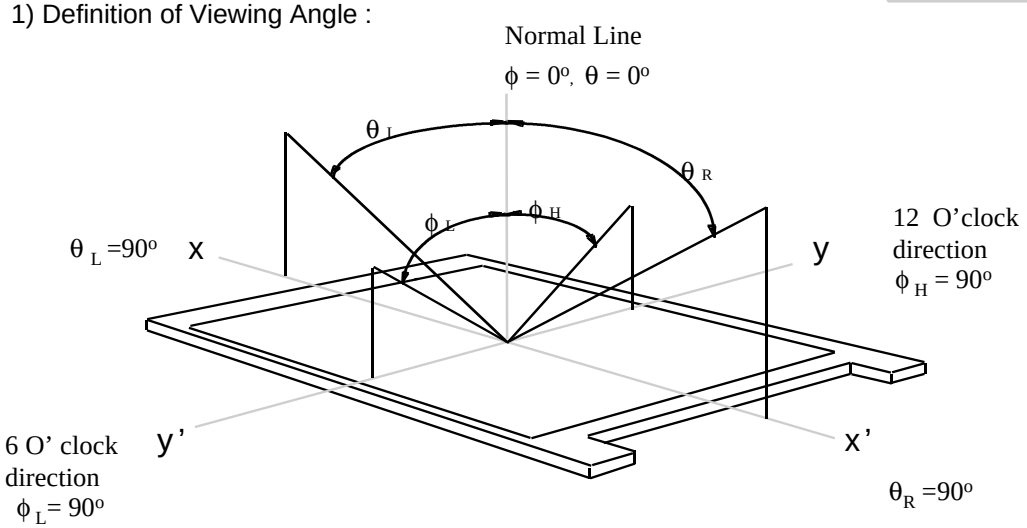
2. OPTICAL CHARACTERISTICS

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°C , V_{DD}=5.0V, fv= 60Hz, f_{DCLK}=65MHz, I_L = 4.0mA

ITEM		SYMBOL	CONDITION	MIN.	TYP.	MAX.	UNIT	
Contrast Ratio		CR		100	-	-		(2),(5)
Response Time at 25 °C	Rise	T_R		-	10	30	msec	(3)
	Fall	T_F		-	35	50		
Average Luminance of White (CENTER)		Y_{CENTER}	ϕ = 0 θ = 0	70	90	-	cd/m^2	4.0mA (4)
Color Chromaticity (CIE)	Red	R_x		0.537	0.577	0.617		(1),(5)
		R_y		0.308	0.338	0.368		
	Green	G_x	Viewing Normal Angle	0.280	0.310	0.340		
		G_y		0.533	0.563	0.593		
	Blue	B_x		0.128	0.158	0.188		
		B_y		0.127	0.157	0.187		
	White	W_x		0.280	0.310	0.340		
		W_y		0.316	0.346	0.366		
Viewing Angle	Hor.	θ_L	CR≥ 10	-	45	-	Degrees	
		θ_R		-	45	-		
	Ver.	ϕ_H		-	20	-		
		ϕ_L		-	40	-		
13 Points White Variation		δ_W				2.0		(6)

Note 1) Definition of Viewing Angle :

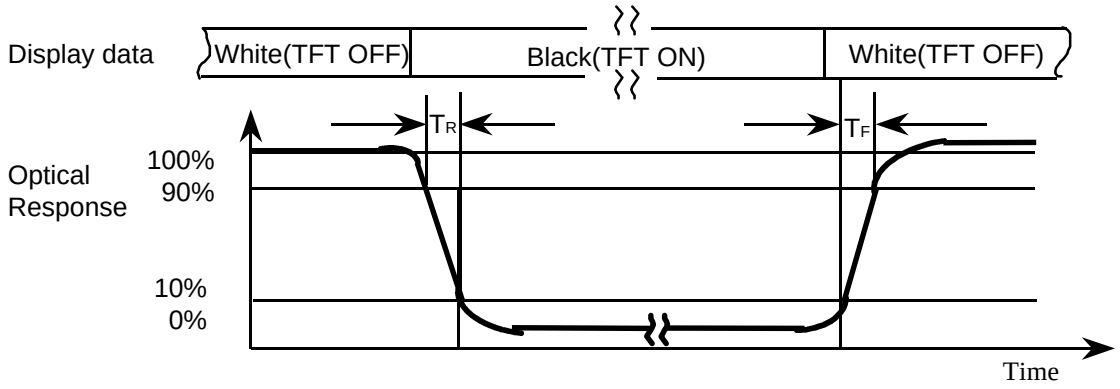


Note 2) Definition of Contrast Ratio (CR) :

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

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

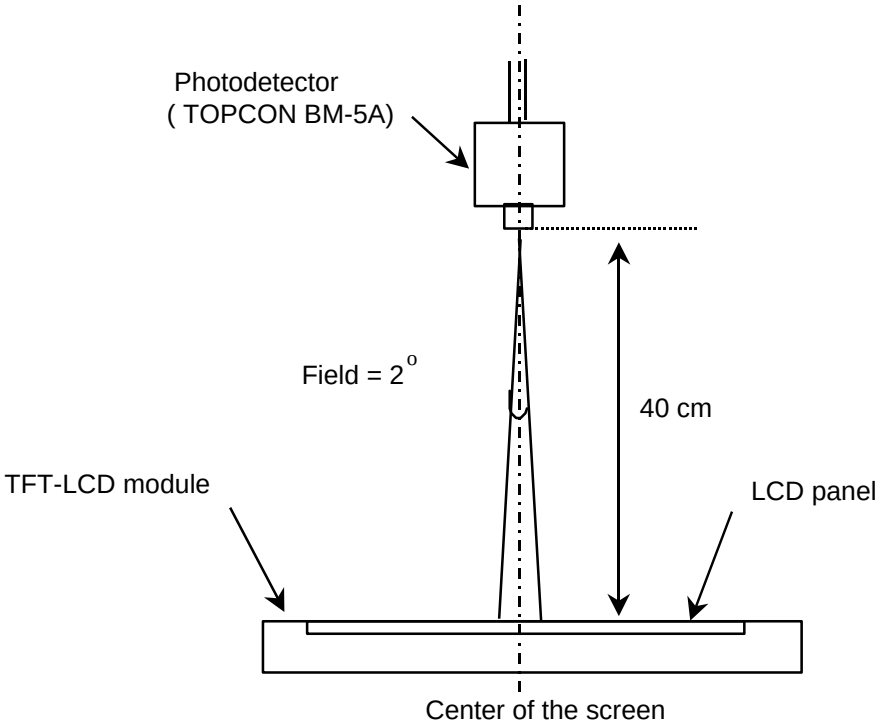
Note 3) Definition of Response time :



Note 4) Definition of Luminance of White : measure the luminance of white at 7 point.

Y Center = POINTS : ⑦ at FIGURE OF NOTE 6)

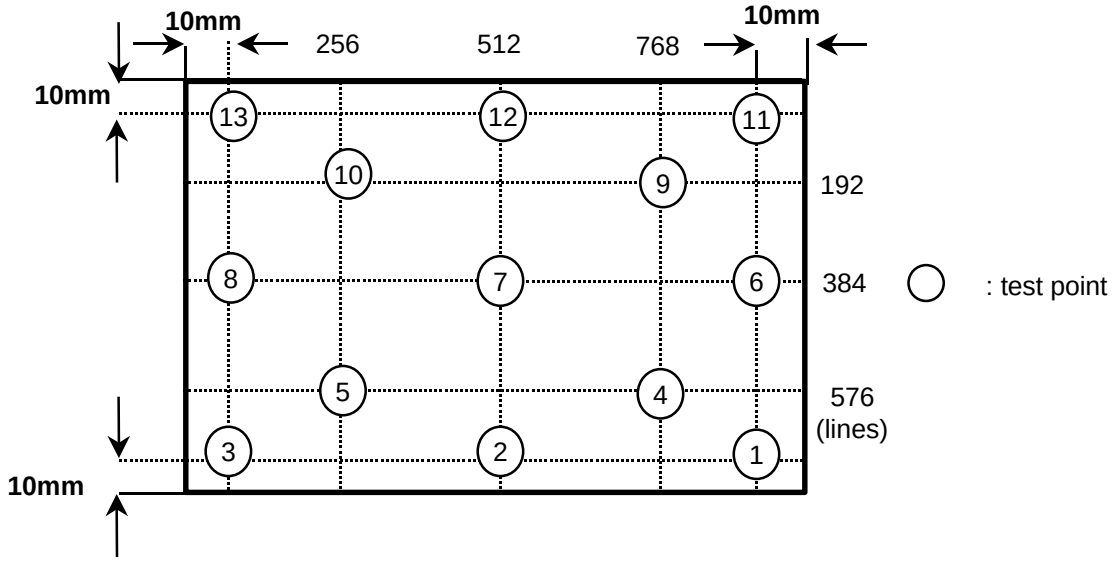
Note 5) After stablizing and leaving the panel alone at a given temperature for 30 min , the measurement should be executed. Measurement should be executed in a stable, windless,and dark room.
30 min after lighting the backlight. This should be measured in the center of screen.
Lamp current : 4.0mA
Environment condition : Ta = 25°C ± 2 °C



Optical characteristics measurement setup

Note 6) Definition of 13 points white variation (δ_W), [① ~ ⑬]

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



3. ELECTRICAL CHARACTERISTICS

3.1 TFT LCD MODULE

Ta=25 ± 2 °C

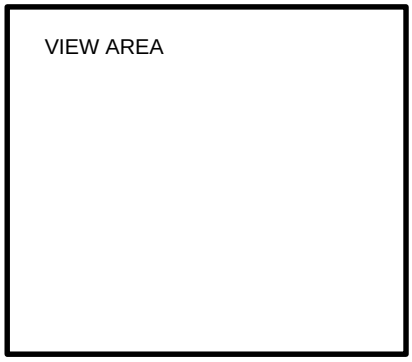
ITEM		SYMBOL	MIN	TYP	MAX	UNIT	NOTE
Voltage of Power Supply		V_{DD}	4.75	5.0	5.25	V	
Differential Input Voltage for LVDS Receiver Threshold	High	V_{IH}	-	-	+100	mV	V_{CM}=+1.2V
	Low	V_{IL}	-100	-	-	mV	
Vsync Frequency		fv	-	60	-	Hz	
Hsync Frequency		f_H	-	48.3	-	KHz	
Main Frequency		f_{DCLK}	-	65	-	MHz	
Rush Current		I_{RUSH}	-	-	1.5	A	(4)
Current of Power Supply	White	I_{DD}	-	190	-	mA	(2),(3)*a
	Mosaic		-	230	-	mA	(2),(3)*b
	Max Pattern		-	330	370	mA	(2),(3)*c

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

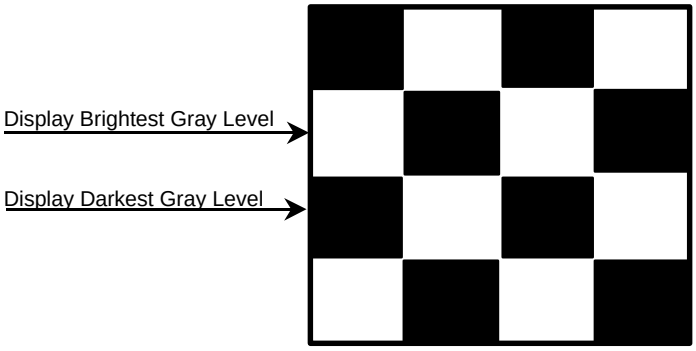
(2) f_V=60Hz, f_{DCLK} =65MHZ, Vdd = 5.0V , DC Current.

(3) Power dissipation pattern

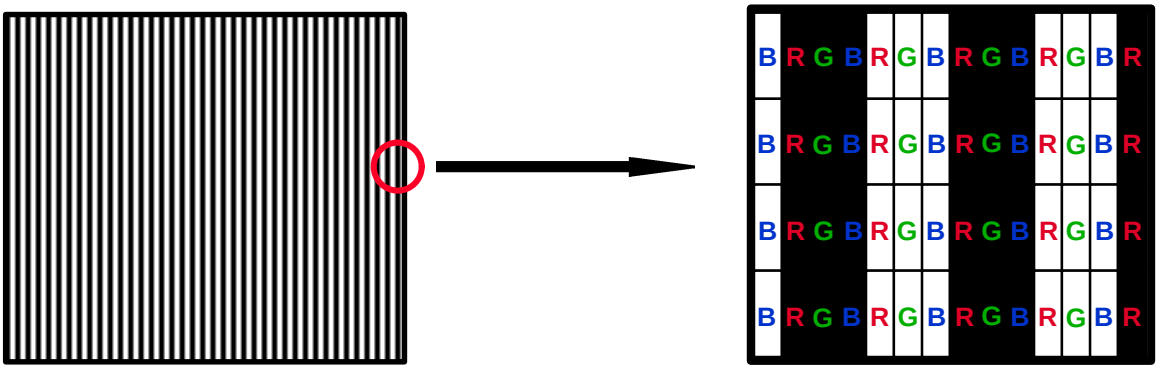
*a) White Pattern



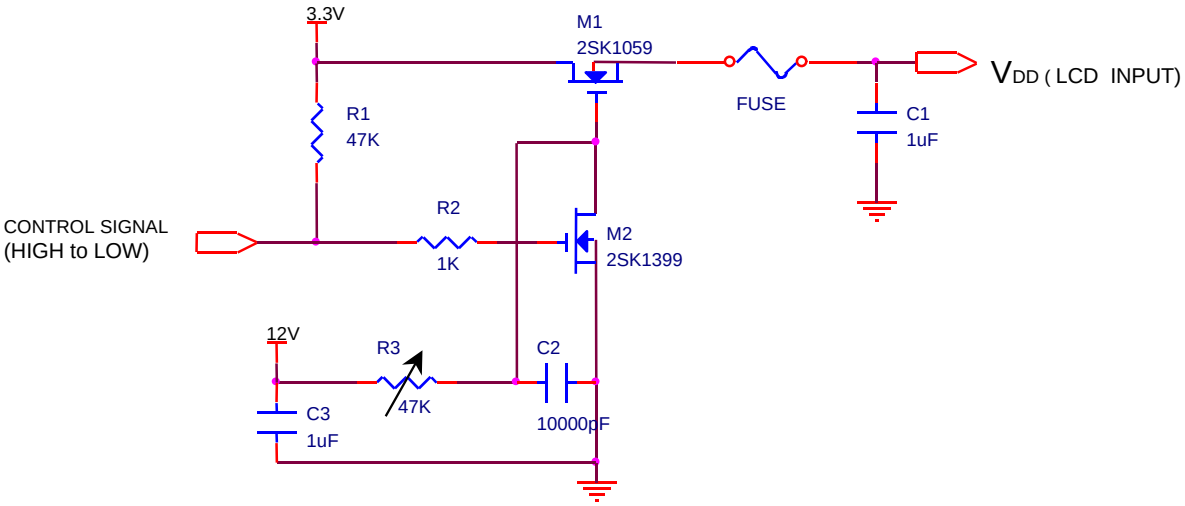
*b) Mosaic Pattern



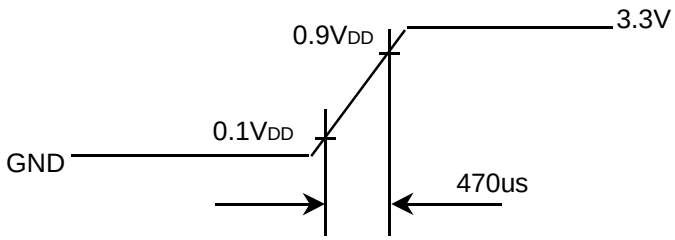
*c) Vertical Stripe Pattern



4) Rush current measurement condition



VDD rising time is 470us



3.2 BACK-LIGHT UNIT

The backlight 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.

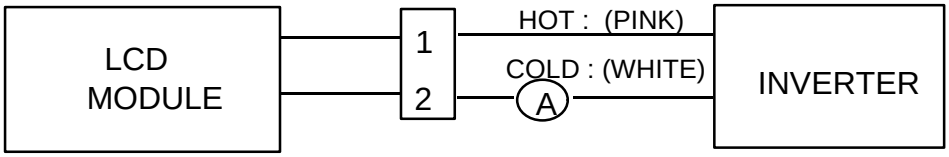
INVERTER : SEM SIC130T
LAMP : HMBS22J( )205NS/AXS

Ta=25 ± 2 °C

ITEM	SYMBOL	MIN	TYP	MAX	UNIT	NOTE
Lamp Current	I_L	2.0	6.8	7.0	mArms	(1)
Lamp Voltage	V_L		475		Vrms	
Frequency	f_L	30	-	60	kHz	(2)
Power Consumption	P_L		3.23		W	(3)
Lamp Operating Life Time	Hr	10,000	-	-	Hour	(4)
Startup Voltage	V_S	-	-	800 (25°C) 1000 (0°C)	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 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.



Switching Frequency : 30 ~ 60KHz

SEM SIC130T

(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.

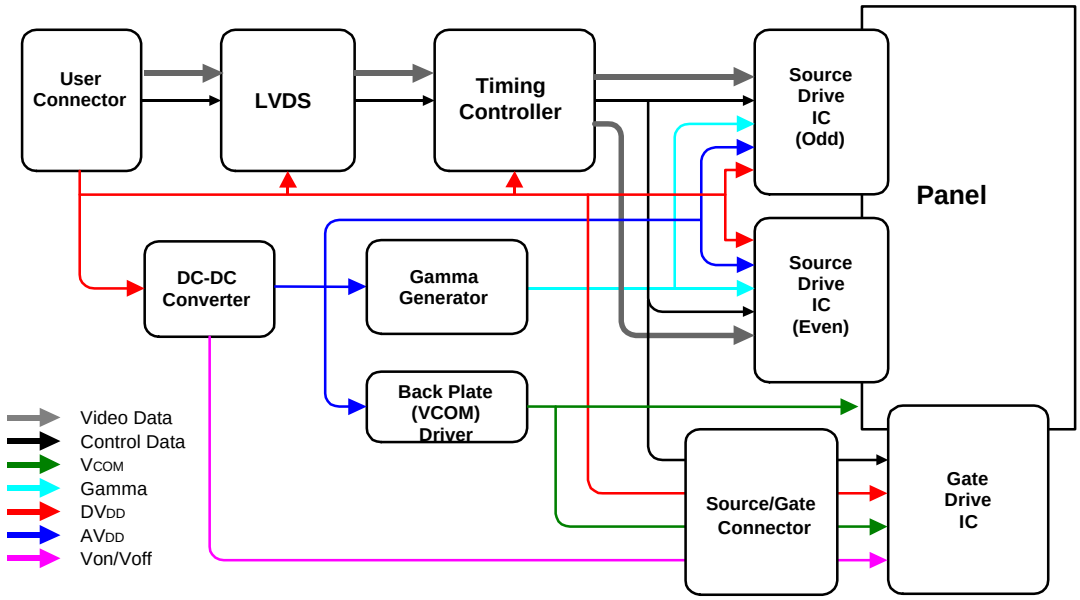
(3) refer to I_L x V_L to calculate.

(4) Lamp lifetime (Hr) can be defined as the time its brightness becomes 50% comparing with the original when it keeps operating under the following condition.
Ta = 25 ±2 °C and I_L = 7.0 mArms

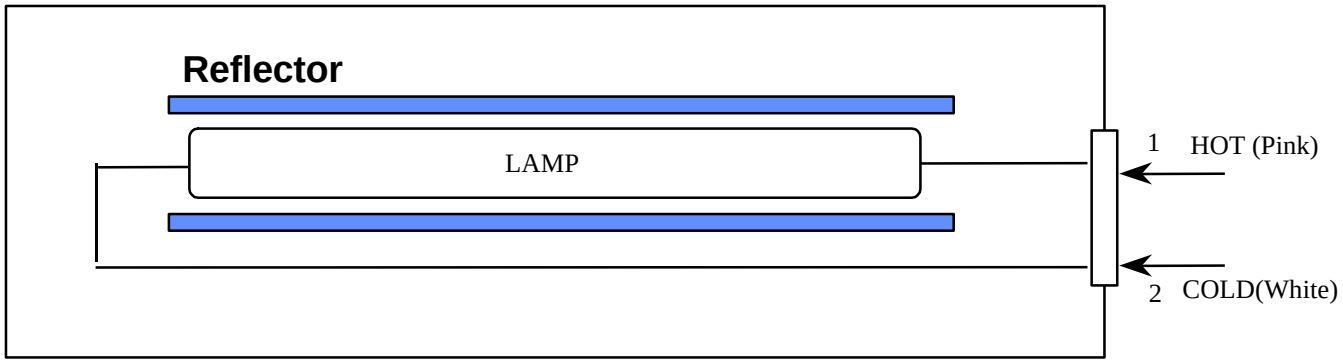
(5) The inverter open voltage - this voltage should be measured after ballast capacitor- have to be larger than the lamp startup voltage, otherwise backlight may has blinking for a moment after turns on or not be turn on.
If an inverter has shutdown function it should keep its open voltage for longer than 1 second without lamp connection.

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.

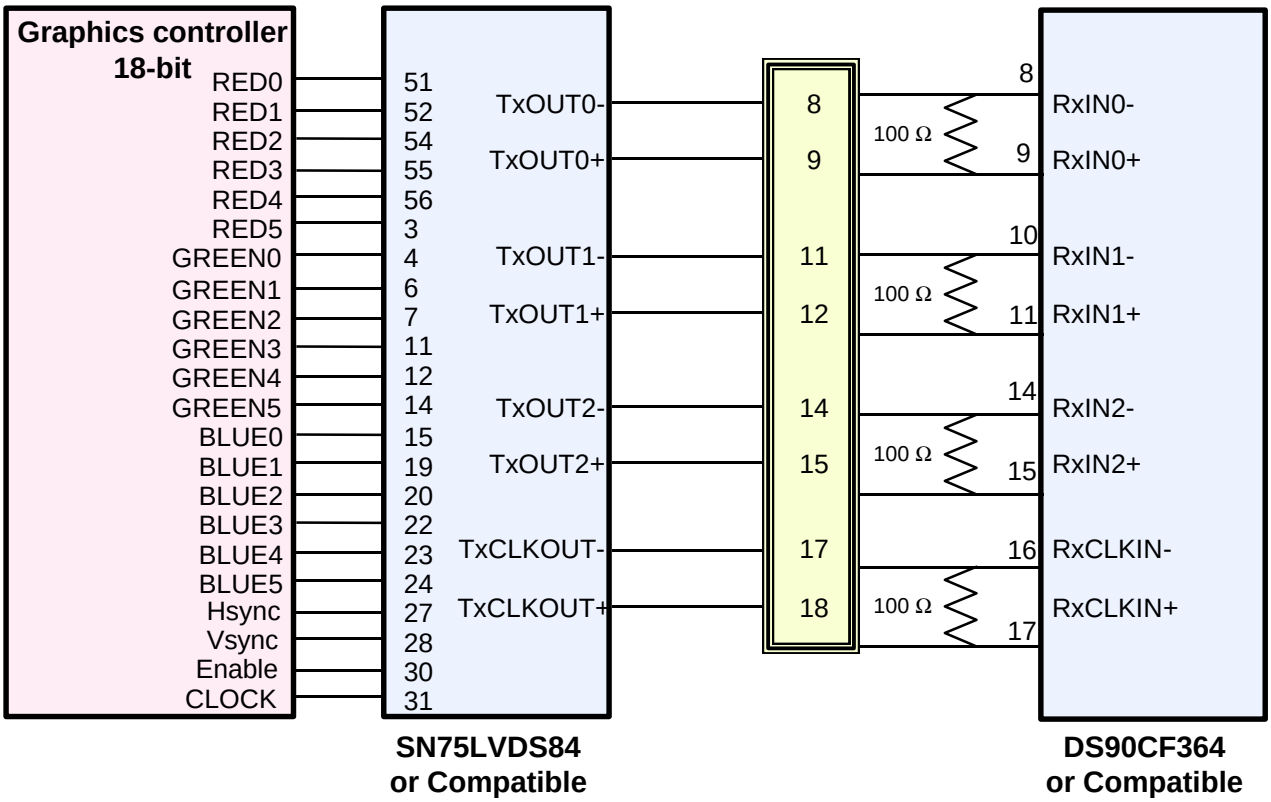
5. INPUT TERMINAL PIN ASSIGNMENT

5.1. Input Signal & Power (LVDS, Connector : JAE FI-SEB20P-HF-A)

PIN NO	SYMBOL	FUNCTION	POLARITY	REMARK
1	VDD	Power Supply +5.0V		
2	VDD	Power Supply +5.0V		
3	GND	Power Ground		
4	GND	Power Ground		
5	N/C	Reserved		
6	N/C	Reserved		
7	GND	LVDS Ground		
8	Rxin0 -	Receiver Signal(-)	Negative	
9	Rxin0 +	Receiver Signal(+)	Positive	
10	GND	LVDS Ground		
11	Rxin1 -	Receiver Signal(-)	Negative	
12	Rxin1 +	Receiver Signal(+)	Positive	
13	GND	LVDS Ground		
14	Rxin2 -	Receiver Signal(-)	Negative	Pixel clock (65MHz)
15	Rxin2 +	Receiver Signal(+)	Positive	
16	GND	LVDS Ground		
17	Rxclk -	Clock Signal(-)	Negative	
18	Rxclk +	Clock Signal(+)	Positive	
19	GND	LVDS Ground		
20	N/C	Reserved		

5.2 LVDS Interface

FLAT LINK INTERFACE



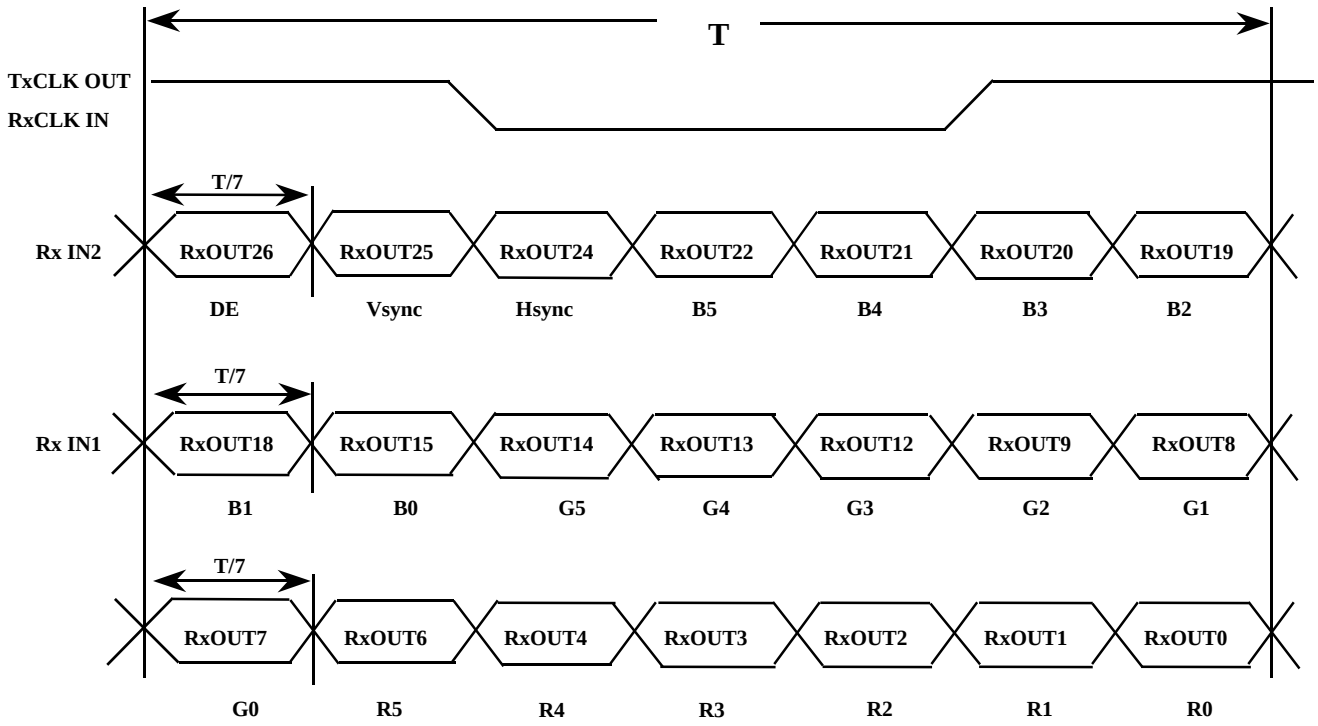
Note : The LCD Module uses a 100ohm resistor between positive and negative lines of each receiver input.

5.3 BACK LIGHT UNIT

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

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

5.4 Timing Diagrams of LVDS For Transmission

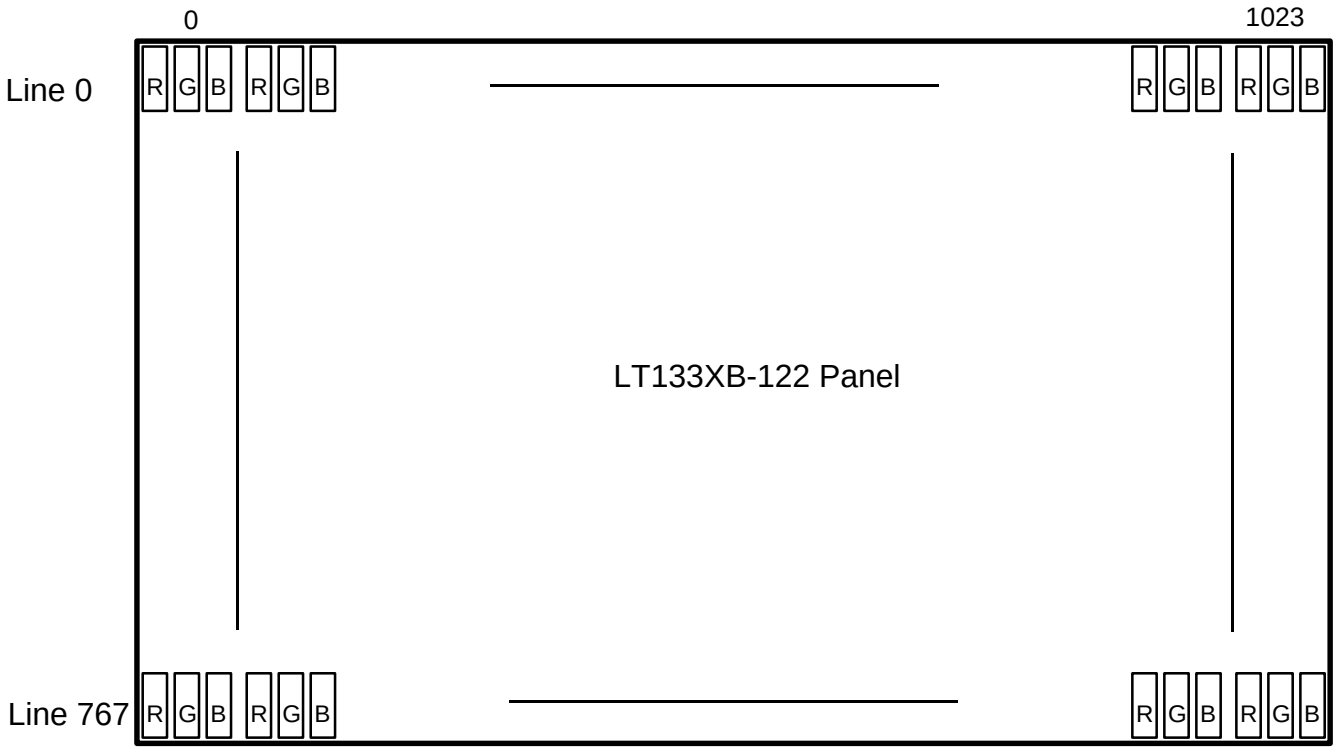


5.5 Input Signals, Basic Display Colors and Gray Scale of Each Color

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	
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)
Note 2)Input signal: 0 =Low level voltage, 1=High level voltage

5.6 Pixel Format in the display



6. INTERFACE TIMING

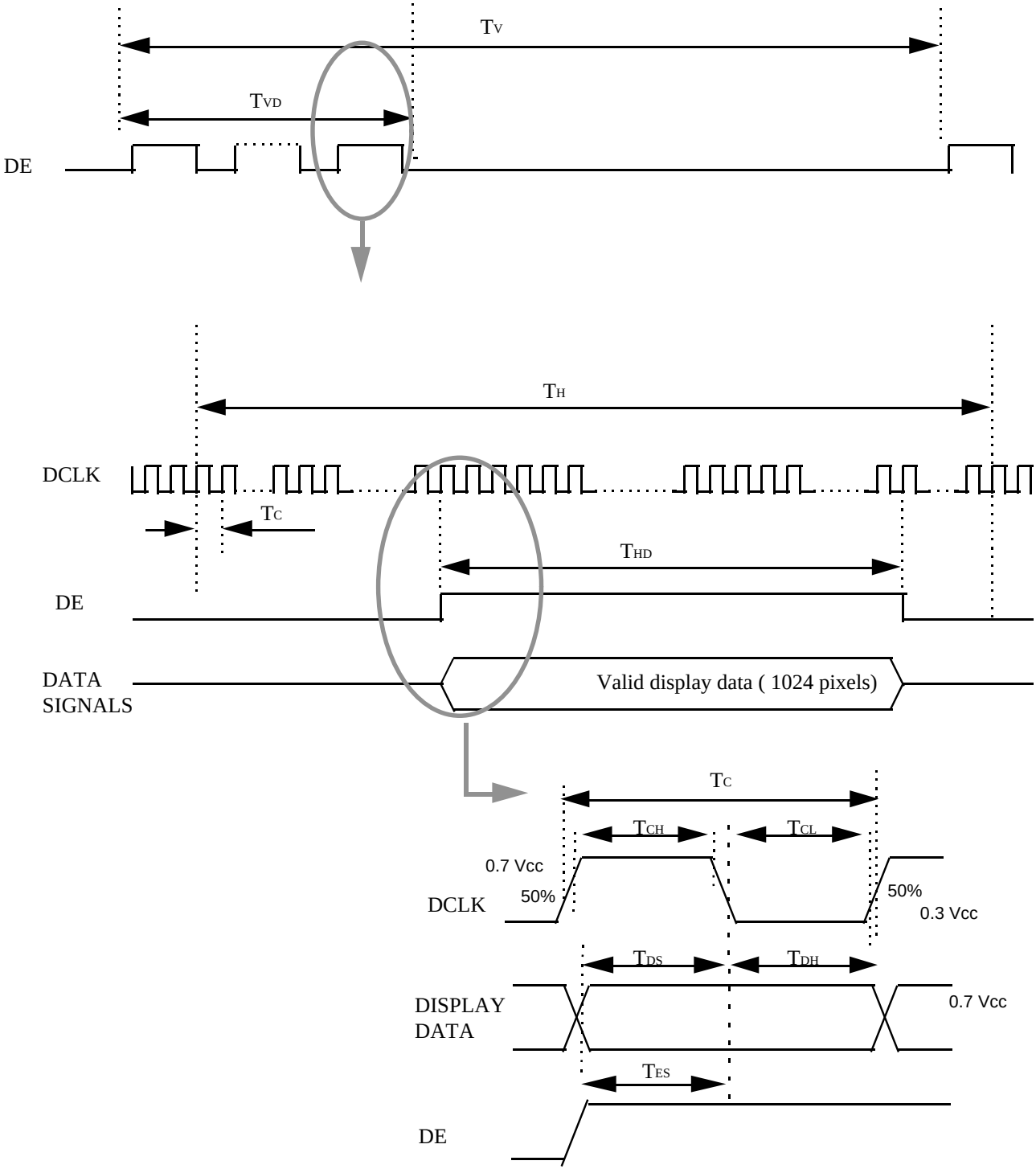
6.1 Timing Parameters

Signal	Item	Symbol	MIN	TYP	MAX	Unit	Note
Clock	Frequency	1 / Tc	-	65	-	MHz	
	High Time	T_{CH}	2	-	-	nsec	
	Low Time	T_{CL}	2	-	-	nsec	
Data	Setup Time	T_{DS}	2	-	-	nsec	
	Hold Time	T_{DH}	2	-	-	nsec	
Data Enable	Setup Time	T_{ES}	2	-	-	nsec	(1)
Frame Frequency	Cycle	T_V	-	806	-	lines	
Vertical Active Display Term	Display Period	T_{VD}	768	768	768	lines	
One Line Scanning Time	Cycle	T_H	-	1344	-	clocks	(2)
Horizontal Active Display Term	Display Period	T_{HD}	-	1024	-	clocks	

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

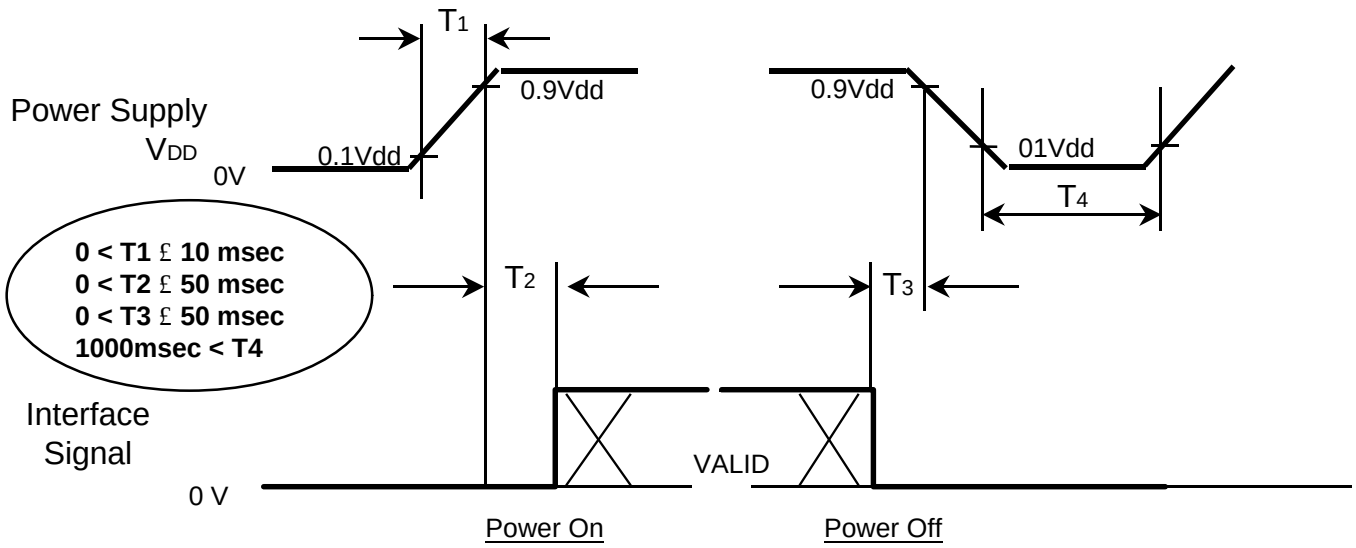
(2) The duration of DE [DTMG] signal must be longer than 1 clock period at every horizontal sync. period

6.2 Timing diagrams of interface signal



6.3. Power ON/OFF Sequence

: To prevent a latch-up or DC operation of the LCD module, the power on/off sequence shall be as shown 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 backlight turns on before the LCD operation or the LCD turns off before the backlight turns off, the display may momentarily become white.

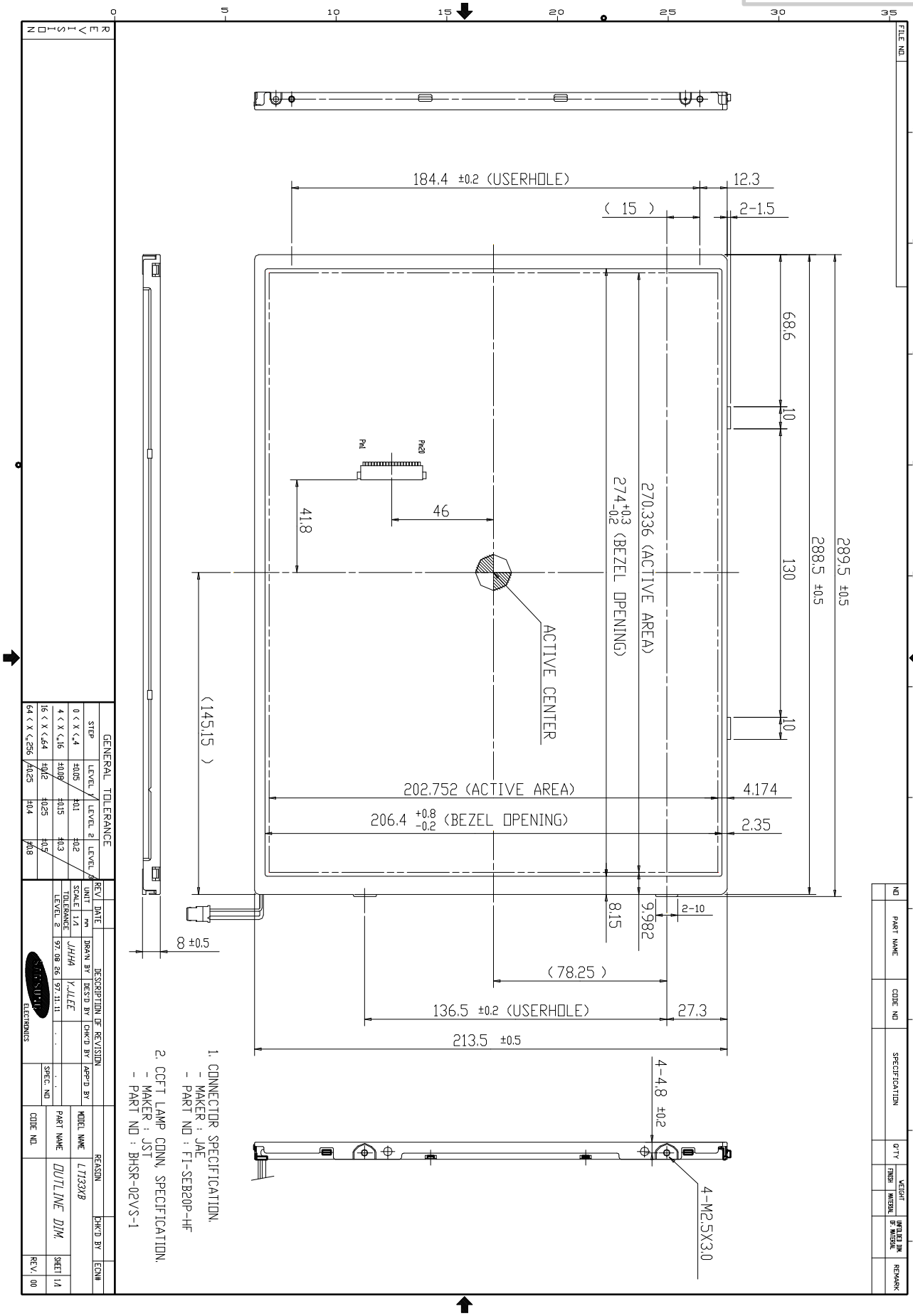
(3) In case of V_{DD} = off level, please keep the level of input signals on the low or keep a high impedance.

(4) 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. Mechanical Outline Dimension

Preliminary



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 cause 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 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.