

Product Information

ISSUE DATE : 2002-06-26
MODEL : LTM190U1-L02

Note : This Product information is subject to change after 3 months of issuing date

Prepared by AMLCD Application Engineering Group

Samsung Electronics Co . , LTD.

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General Description

* Description

LTM190U1-L02 is a color active matrix TFT (Thin Film Transistor) liquid crystal display (LCD) that uses amorphous silicon TFTs as switching devices. This model is composed of a TFT LCD panel, a driver circuit and a back-light system. The resolution of a 19.0" contains 1600 x 1200 pixels and can display up to 256 gray colors with wide viewing angle of 85° or higher in all directions. (Vertical viewing angle : 170° , Horizontal viewing angle : 170°)

* Features

- High contrast ratio, high aperture structure
- PVA (Patterned Vertical Alignment) mode
- Wide viewing angle
- High speed response
- UXGA(1600 x 1200 pixels) resolution
- Low power consumption
- 2 triple CCFTs (Cold Cathode Fluorescent Tube)
- DE only mode
- LVDS(Low Voltage Differential Signaling) Interface

* Applications

Workstation & desktop monitors

Display terminals for industrial and medical application products

Desktop Publishing(DTP) Monitors

* General information

Items	Specification	Unit	Note
Display area	386.4(H) * 289.8(V) (19.0")	mm	
Driver element	a-Si TFT Active matrix		
Display colors	256	gray colors	
Number of pixels	1,600 * 1,200	pixel	
Pixel arrangement	Vertical Stripe		
Pixel pitch	0.2415(H) × 0.2415(V)	mm	
Display mode	Normally Black		
Surface treatment	Haze 25% , Hard-Coating (3H)		

*** Mechanical information**

Item		Min.	Typ.	Max.	Note
Module size	Horizontal(H)	414.5	415.0	415.5	mm
	Vertical(V)	325.5	326.0	326.5	mm
	Depth(D)	-	-	26.5	mm
Weight		-	-	3,100	g

1. Absolute Maximum Ratings

1.1 Absolute ratings of environment

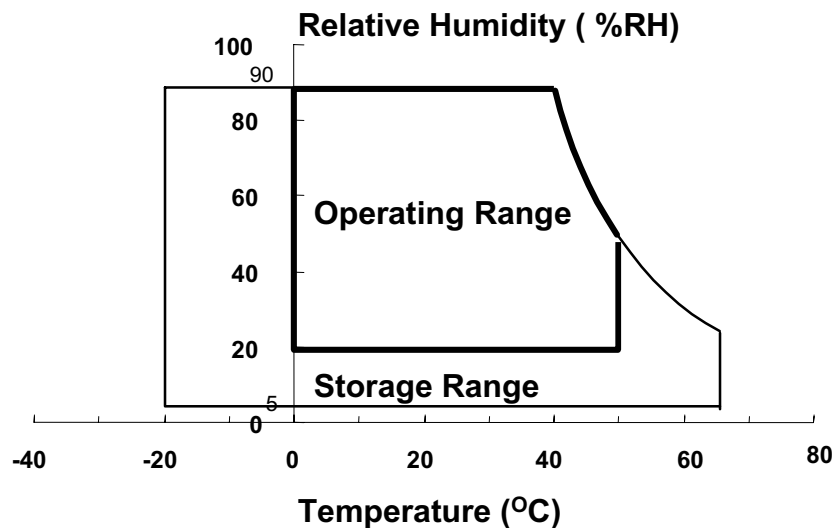
Item	Symbol	Min.	Max.	Unit	Note
Storage temperature	T _{STG}	-20	65	°C	(1)
Operating temperature (Ambient temperature)	T _{OPR}	0	50	°C	(1)
Shock (non - operating)	Snop	-	50	G	(2),(4)
Vibration (non - operating)	Vnop	-	1.5	G	(3),(4)

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

90 % RH Max. ($40\text{ }^{\circ}\text{C} \geq T_a$)

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

- (2) 11ms, sine wave, one time for $\pm X$, $\pm Y$, $\pm Z$ axis
- (3) 10-300 Hz, Sweep rate 10min, 30min for X,Y,Z axis
- (4) At vibration and shock test, the fixture which holds the module to be tested has to be hard and rigid enough so that the module would neither be twisted nor bent by the fixture.



1.2 ELECTRICAL ABSOLUTE RATINGS

(1) TFT LCD Module

(V_{ss} = GND = 0 V)

Item	Symbol	Min.	Max.	Unit	Note
Power Supply Voltage	VDD	V _{ss} -0.5	6.5	V	(1)

NOTE (1) Within Ta (25 ± 2 °C)

(2) BACK-LIGHT UNIT

(Ta = 25 ± 2°C)

Item	Symbol	Min.	Max.	Unit.	Note
Lamp Current	IL	2.0	7.0	mArms	(1),(2)
Lamp Frequency	fL	30	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) Specified values are for a single lamp (Refer to the Note (1) in the page 11 for further information).

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 (1).

Measuring equipment : TOPCON BM-5A , BM-7, PHOTO RESEARCH PR650
Eldim EZ-Contrast

(Inverter Freq. : 54kHz) * Ta = 25 ± 2°C, VDD=5V, fv= 60Hz, fDCLK=54MHz, IL = (5.5)mArms

Item		Symbol	Condition	Min.	Typ.	Max.	Unit	Note
Contrast Ratio (Center of screen)		C/R	Normal f = 0 q = 0	(650)	(700)	-		(3) BM-5A
Response Time	Rising	Tr		-	15	20	msec	(4) BM-7
	Falling	Tf		-	10	15		
Luminance of White (Center of screen)		YL			(600)	(700)	-	cd/m2
Color Chromaticity (CIE 1931)	White	Wx	Viewing Angle	TYP -0.03	(0.310)	TYP -0.03		(6) PR650
		Wy			(0.330)			
Viewing Angle	Hor.	θ L	CR≥10	80	85	-	Degrees	(7) BM-5A
		θ R		80	85	-		
	Ver.	φ H		80	85	-		
		φ L		80	85	-		
Brightness Uniformity (9 points)		Buni		-	-	(15)	%	(8) BM-5A
Crosstalk		CT		-	-	5.0	%	(9) BM-5A

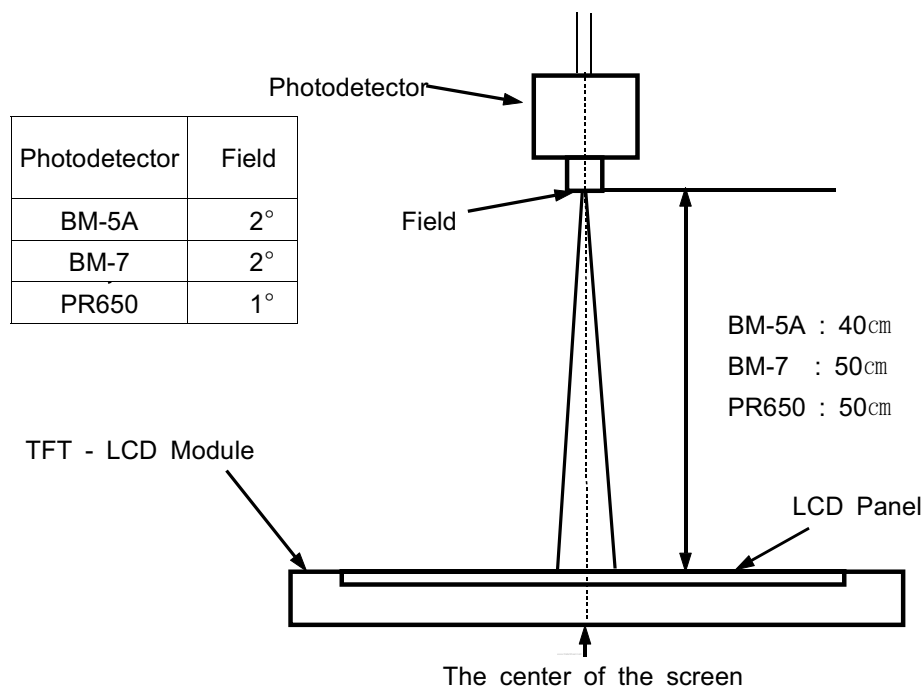
Note 1) Test Equipment Setup

Measurement should be executed in a stable, windless, and dark room after lighting the back-light for 30 min to stabilize at a given temperature.

This should be measured at the center of screen.

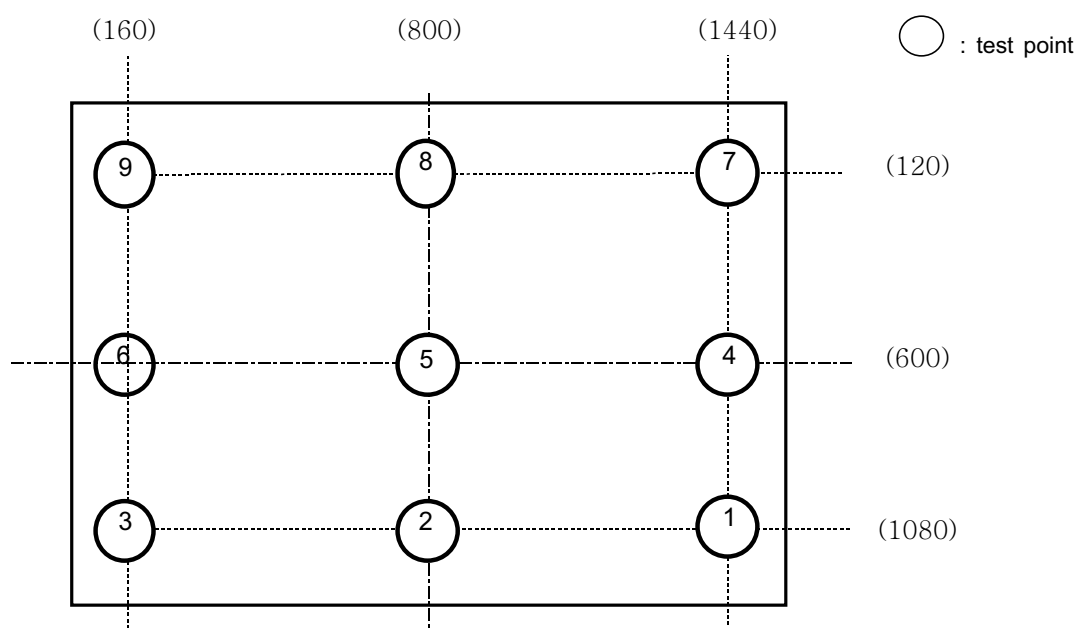
Single lamp current : (5.5)mA (Refer to the note(1) in the page 11 for more information.)

Environment condition : $T_a = 25 \pm 2 \text{ }^{\circ}\text{C}$



Optical Measuring Equipment Setup

Note 2) Definition of test point



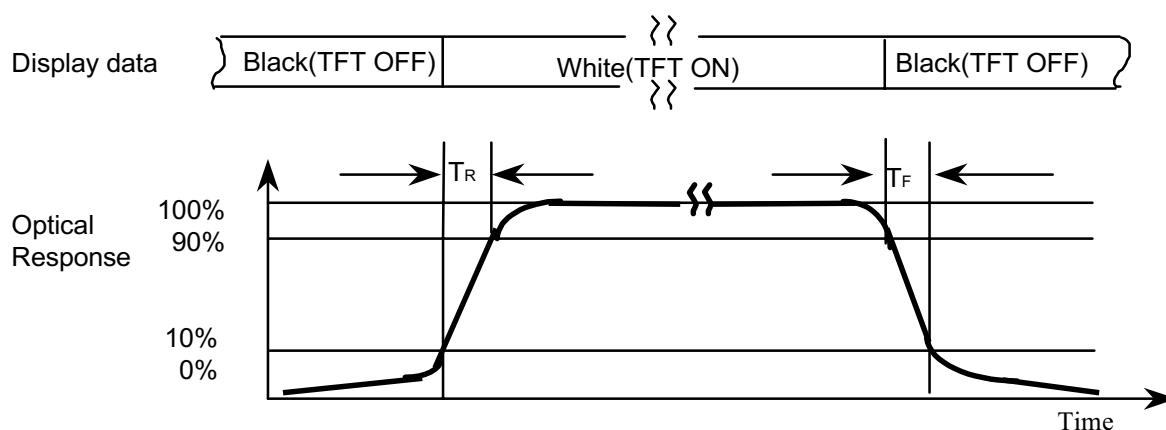
Note 3) Definition of Contrast Ratio (C/R) : Ratio of gray max (Gmax) & gray min (Gmin) at the center point⑤ of the panel

$$CR = \frac{G_{\max}}{G_{\min}}$$

Gmax : Luminance with all pixels white

Gmin : Luminance with all pixels black

Note 4) Definition of Response time : Sum of T_r , T_f

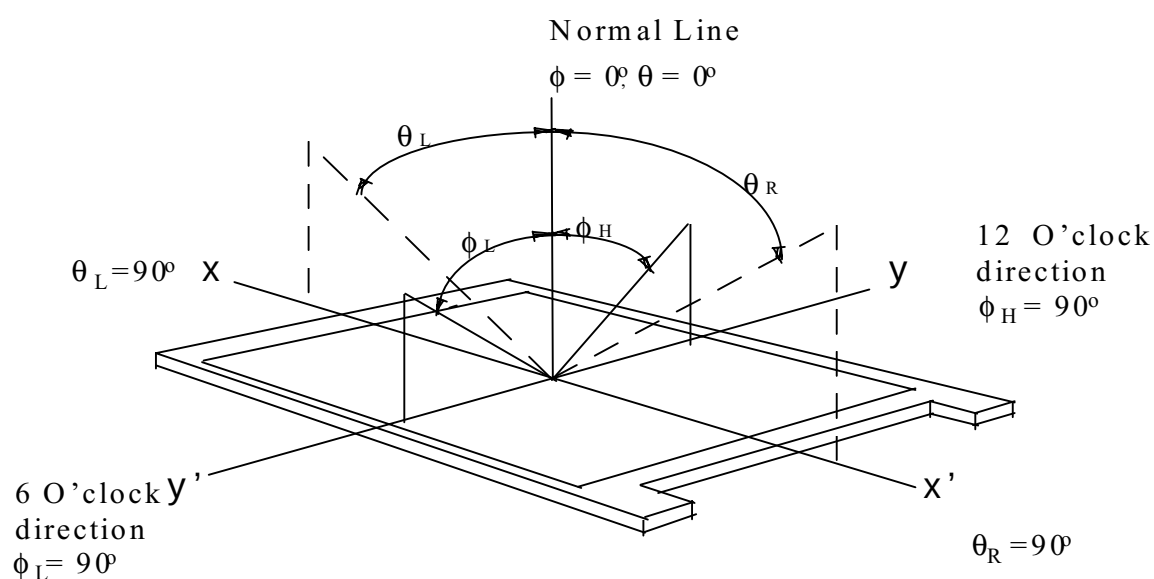


Note 5) Definition of Luminance of White : Luminance of white at center point⑤.

Note 6) Definition of Color Chromaticity (CIE 1931)

Color coordinate of Red , Green , Blue & White at center point⑤.

Note 7) Definition of Viewing Angle : Viewing angle range ($CR \geq 10$)



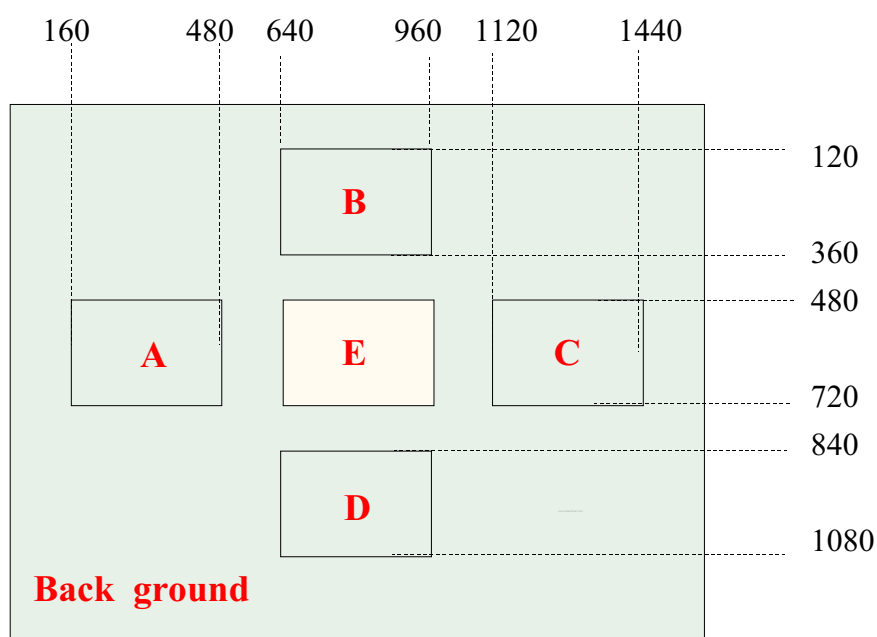
Note 8) Definition of 9 points brightness uniformity

$$B_{uni} = 100 * \frac{(B_{max} - B_{min})}{B_{max}}$$

Bmax : Maximum brightness

Bmin : Minimum brightness

Note 9) Definition of Crosstalk Test Method (Refer to the VESA STD)



Procedure

Step (1) Determine background and foreground gray levels (colors) to select the worst case shadowing pattern

(Ex Background : 50% gray white pattern , Foreground : Pure white pattern)

Step (2) Determine the worst shadowing box (between Box A,B,C,D & E) using the same condition at Step (1) gray levels (colors)

Step (3) Determine test most shadowing position of selected box at Step (2)

Step (4) Check the brightness of selected position of Step (3) with selected box(at Step (2)) & without selected box (at Step (2))

$$CT = \frac{|L_{max} - L_{min}|}{L_{min}} * 100\%$$

Lmax : the larger Brightness value of selected position

Lmin : the smaller brightness value of selected position

3. Electrical Characteristics

3.1 TFT LCD MODULE

Ta = 25°C

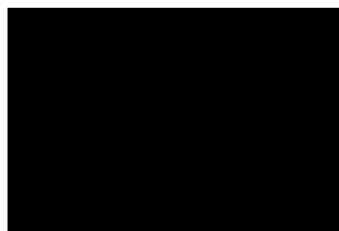
Item		Symbol	Min.	Typ.	Max.	Unit	Note
Voltage of Power Supply		V _{DD}	4.5	5.0	5.5	V	(1)
Interface type		LVDS	DS90CF387		DS90CF388 Pair		
Current of Power Supply	(a)Black	P _{DD}	-	4.3	5.1	Watt	(2),(3)
	(b)Mosaic		-	5.3	6.0	Watt	
	(c)2 Line Vertical		-	6.3	7.6	Watt	
Vsync Frequency		f _V	58	60	60	Hz	
Hsync Frequency		f _H	70	75	75	kHz	
Main Frequency		f _{DCLK}	62	81	-	MHz	
Rush Current		I _{RUSH}	-	1.3	2.0	A	(4)

Note (1) f_V=60Hz, f_{DCLK} =81MHz, V_{DD} = 5.0V, DC Current.

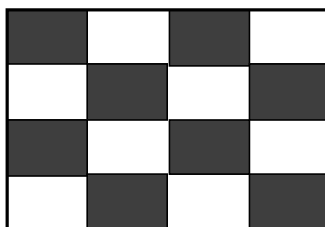
(2) Main pixel clock frequency is the value which is measured at the input of LVDS transmitter.

(3) Power dissipation check pattern(LCD Module only)

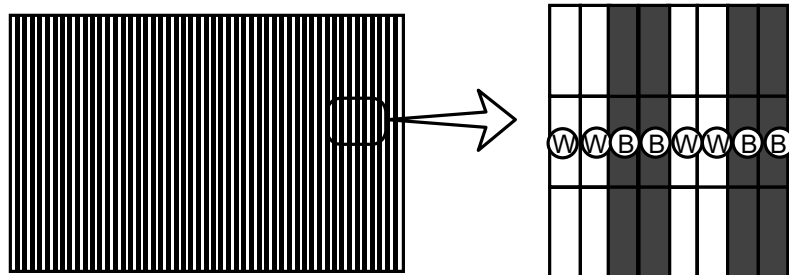
a)Black Pattern



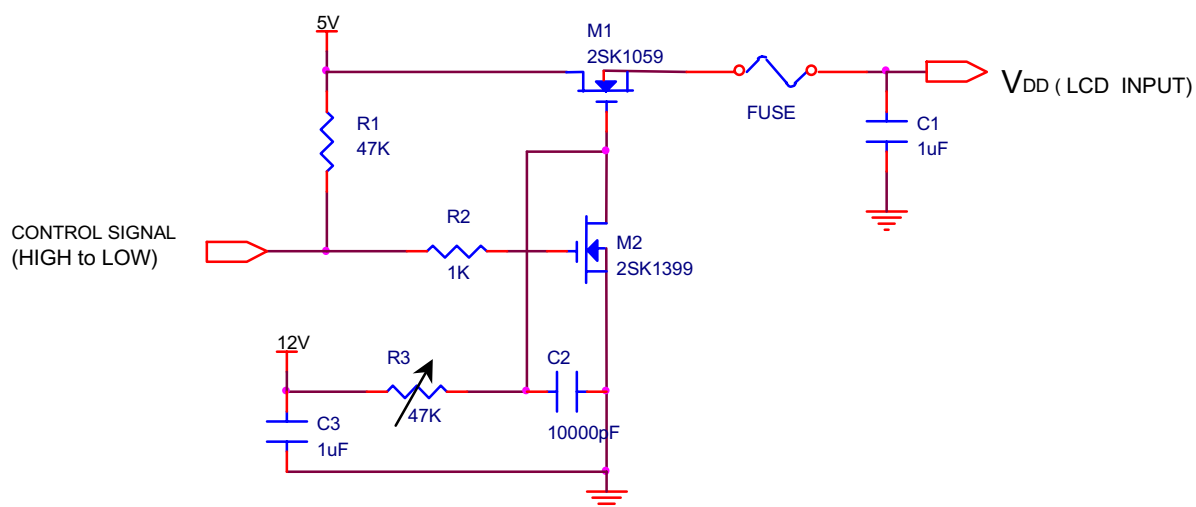
b)Mosaic Pattern



c)2 Line Vertical



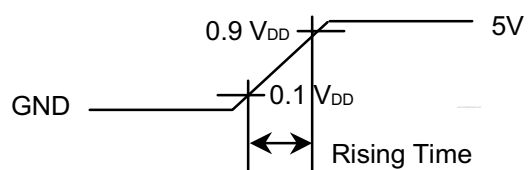
(4) Measurement Conditions



Note : Control Signal : High(+5V) -->Low(Ground)

All Signal lines to panel except for power 5V : Ground

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



3.2 BACK-LIGHT UNIT

The back-light system is an edge - lighting type with 2 triple CCFTs (Cold Cathode Fluorescent Tube). The characteristics of two triple lamps are shown in the following tables.

$T_a = 25 \pm 2^\circ\text{C}$

Item	Symbol	Min.	Typ.	Max.	Unit	Note
Lamp Current	IL	4.5	(5.5)	(5.5)	mArms	(1)
Lamp Voltage	VL	-	830	-	Vrms	
Lamp Frequency	fL	30	-	60	kHz	(2)
Operating Life Time	Hr	20000 1000	30000 -	- -	Hour	(3)
Startup Voltage	Vs	-	-	0°C: 1760 25°C:1260	Vrms	(4)

Note) The inverter must have a symmetric out voltage waveform and be designed on the basis of 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 parameters of an inverter should be carefully designed so as not to produce too much leakage current from high-voltage output of the inverter.

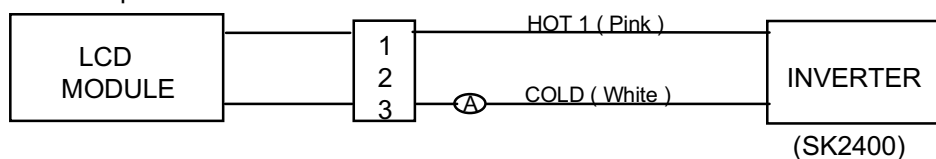
When you design or order the inverter, please make sure that a poor lighting caused by the mismatch of the back-light and the inverter(miss lighting, flicker, etc.) never occur. When you confirm it, the module should be operated on the same condition as it is installed in your instrument.

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

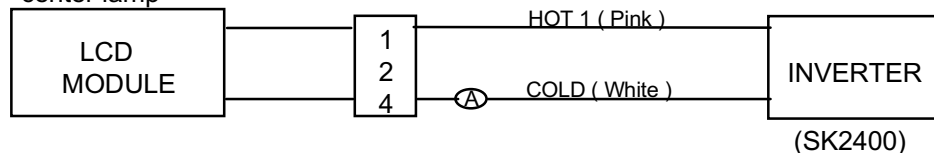
Refer to the block diagram of the back-light unit in the next page for more information.

Specified values are for a single lamp.

* side lamps



* center lamp



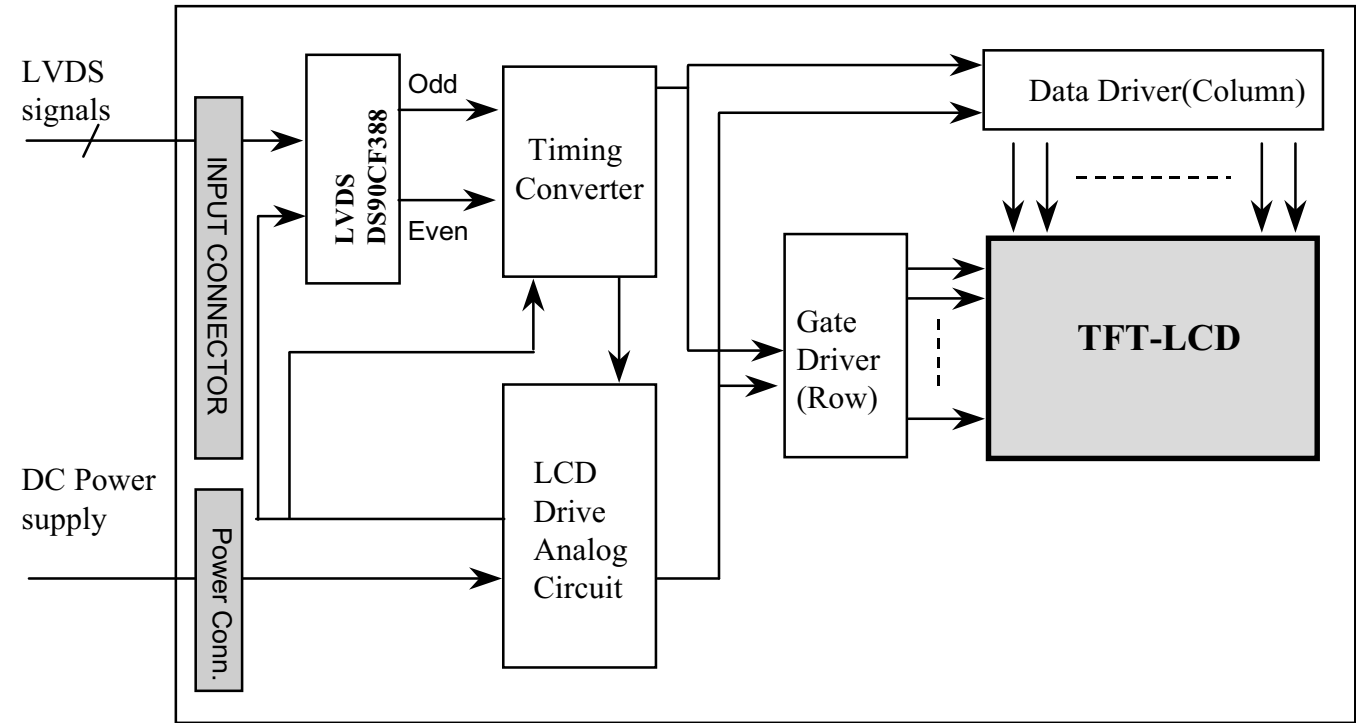
(2) Lamp frequency, which may produce interference with horizontal synchronous frequency which may cause line flow on the display. Therefore lamp frequency should be detached from the horizontal synchronous frequency and its harmonics as far as possible in order to avoid interference.

(3) Lifetime(Hr) of a lamp is defined as the time in which it continues to operate under the condition of $T_a = 25 \pm 2^\circ\text{C}$ and $I_L = 6.5\text{mA}$ until the brightness becomes 50% or lower than its original value.

(4) If an inverter has shutdown function, it should keep its output for over 1 second even if the lamp connector is open. Otherwise the lamps may not be turned on.

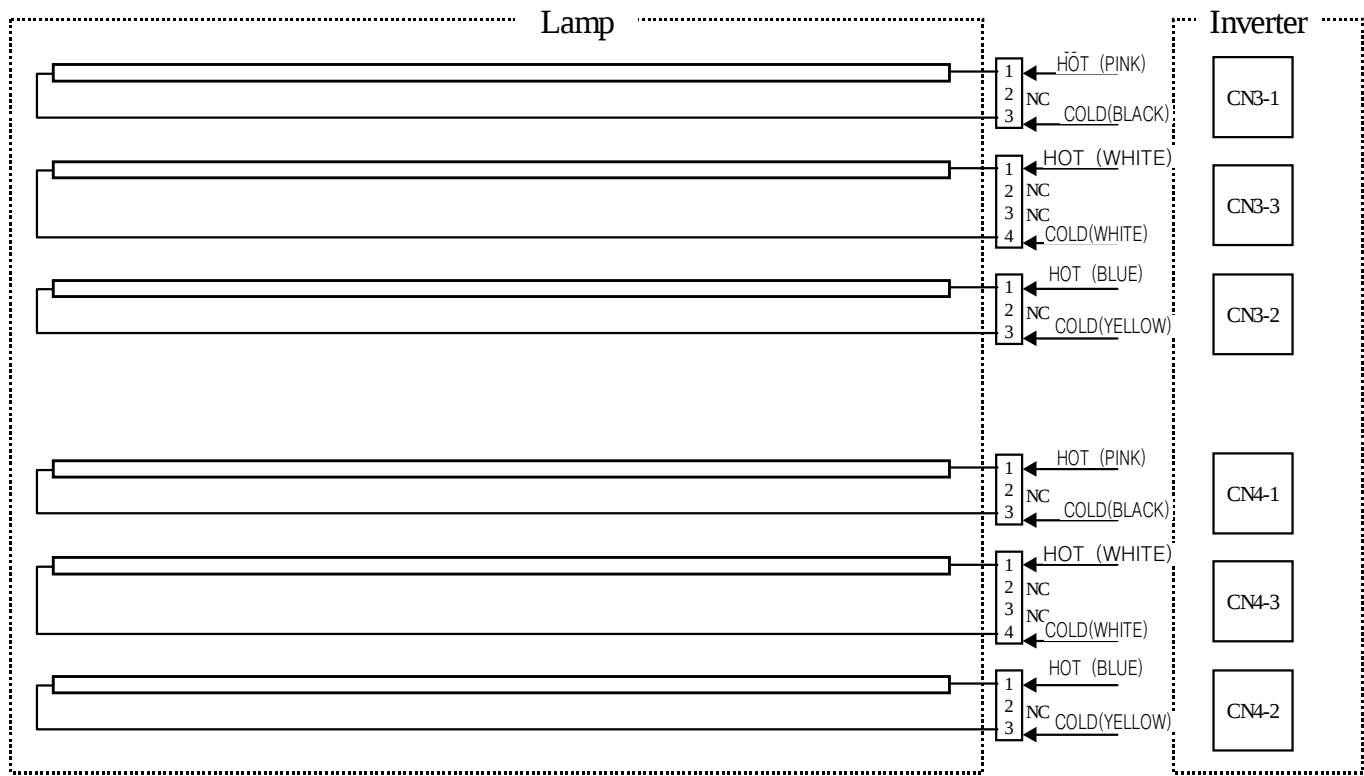
4. Block Diagram

4.1 TFT LCD MODULE



4.2 BACK-LIGHT UNIT

Connector: JST BHR-03VS-1 / JST BHR-04VS-1



5. Input Terminal Pin Assignment

5.1. Input Signal & Power (Connector : JAE F1-WE31P-HF)

Pin No	Symbol	Function
1	GND	Ground
2		
3	A0M	Negative LVDS differential data output
4	A0P	Positive LVDS differential data output
5	A1M	Negative LVDS differential data output
6	A1P	Positive LVDS differential data output
7	A2M	Negative LVDS differential data output
8	A2P	Positive LVDS differential data output
9	GND	Ground
10		
11	CLKM	Negative LVDS differential clock output
12	CLKP	Positive LVDS differential clock output
13	A3M	Negative LVDS differential data output
14	A3P	Positive LVDS differential data output
15	GND	Ground
16		
17	A4M	Negative LVDS differential data output
18	A4P	Positive LVDS differential data output
19	A5M	Negative LVDS differential data output
20	A5P	Positive LVDS differential data output
21	A6M	Negative LVDS differential data output
22	A6P	Positive LVDS differential data output
23	GND	Ground
24		
25	A7M	Negative LVDS differential data output
26	A7P	Positive LVDS differential data output
27	N.C	Reserved
28	N.C	Reserved
29	N.C	Reserved
30	N.C	Reserved
31	N.C	Reserved

5.2 Input Power (Connector : Molex 53261-1290)
(Mating Connector : Molex 51021-1200)

Pin No	Symbol	Function
1	+5V	Module Input Vcc
2		
3		
4		
5		
6		
7	GND	Power Ground
8		
9		
10		
11		
12		

5.3 Table of Gray Scale

Color	Display	Data Signal							
Gray Scale	Black	G7	G6	G5	G4	G3	G2	G1	G0
	Dark Gray	0	0	0	0	0	0	0	0
		0	0	0	0	0	0	0	1
		0	0	0	0	0	0	1	0
		0	0	0	0	0	0	1	1
		0	0	0	0	0	1	0	0
		0	0	0	0	0	1	0	1
		0	0	0	0	0	1	1	0
		0	0	0	0	0	1	1	1
		0	0	0	0	1	0	0	0
		0	0	0	0	1	0	0	1
		0	0	0	0	1	0	1	0
		:	:	:	:	:	:	:	:
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		:	:	:	:	:	:	:	:
	↓	1	1	1	1	0	1	0	1
		1	1	1	1	0	1	1	0
		1	1	1	1	0	1	1	1
		1	1	1	1	1	0	0	0
		1	1	1	1	1	0	0	1
		1	1	1	1	1	0	1	0
		1	1	1	1	1	0	1	1
		1	1	1	1	1	1	0	0
		1	1	1	1	1	1	0	1
		1	1	1	1	1	1	1	0
		1	1	1	1	1	1	1	0
		1	1	1	1	1	1	1	0
	White	1	1	1	1	1	1	1	1

Note) Definition of Gray :

Gn : Bit of gray (n = 0~7)

Input Signal : 0 = Low level voltage, 1 = High level voltage

6. Interface Timing

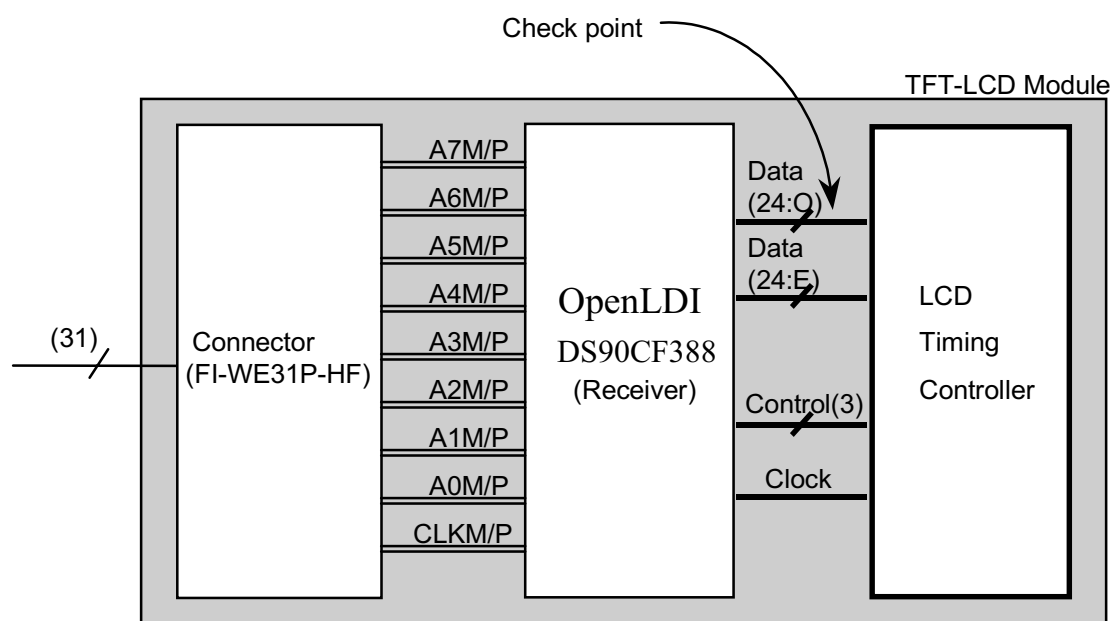
6.1 Timing Parameters (DE only mode)

SIGNAL	ITEM	SYMBOL	MIN.	TYP.	MAX.	UNIT	NOTE
Clock	Frequency	1/Tc	62	81	82	MHz	(1),(2)
	Hgh Time	TCH	1.5	-	-	nsec	
	Low Time	TCL	1.5	-	-	nsec	
Data	Setup Time	TDS	2	-	-	nsec	
	Hold Time	TDH	2	-	-	nsec	
Data Enable	Setup Time	TES	2	-	-	nsec	
Frame Frequency	Cycle	TH	-	16.7	-	msec	
			1208	1250	1250	lines	
Vertical Active Disply Term	Display Period	TVD	1200	1200	1200	lines	
	Verticle Blank Period	TVB	8	-	50	lines	
One Line Scanning Time	Cycle	TH	900	1080	1090	clocks	2pixel/clock
Horizontal Active Display Term	Display Period	THD	800	800	800	clocks	
			1600	1600	1600	pixels	

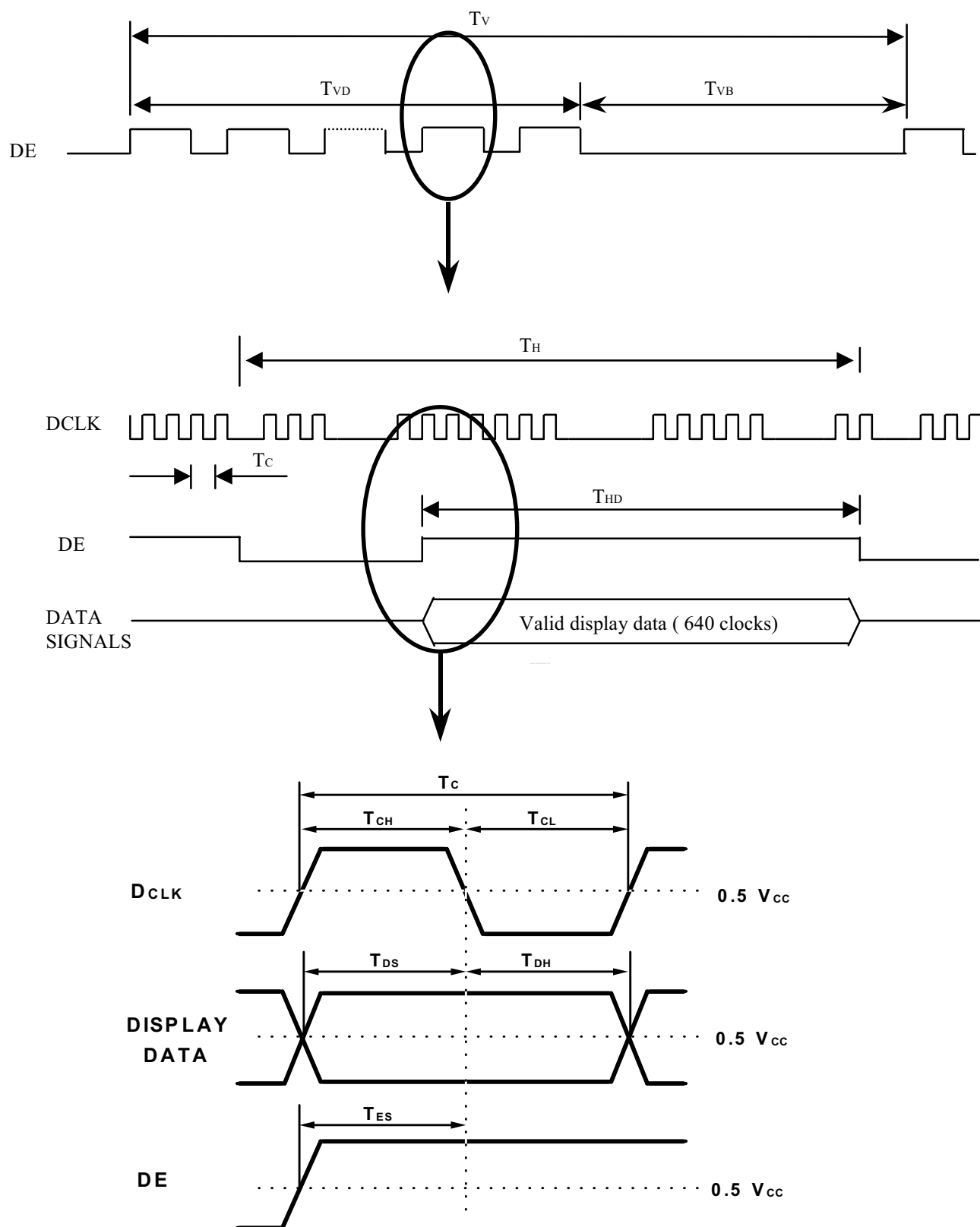
Note (1) Test Point : TTL control signal and CLK at LVDS Tx input terminal in system

(2) Internal Vcc = 3.0V

* Interfacing timing check point

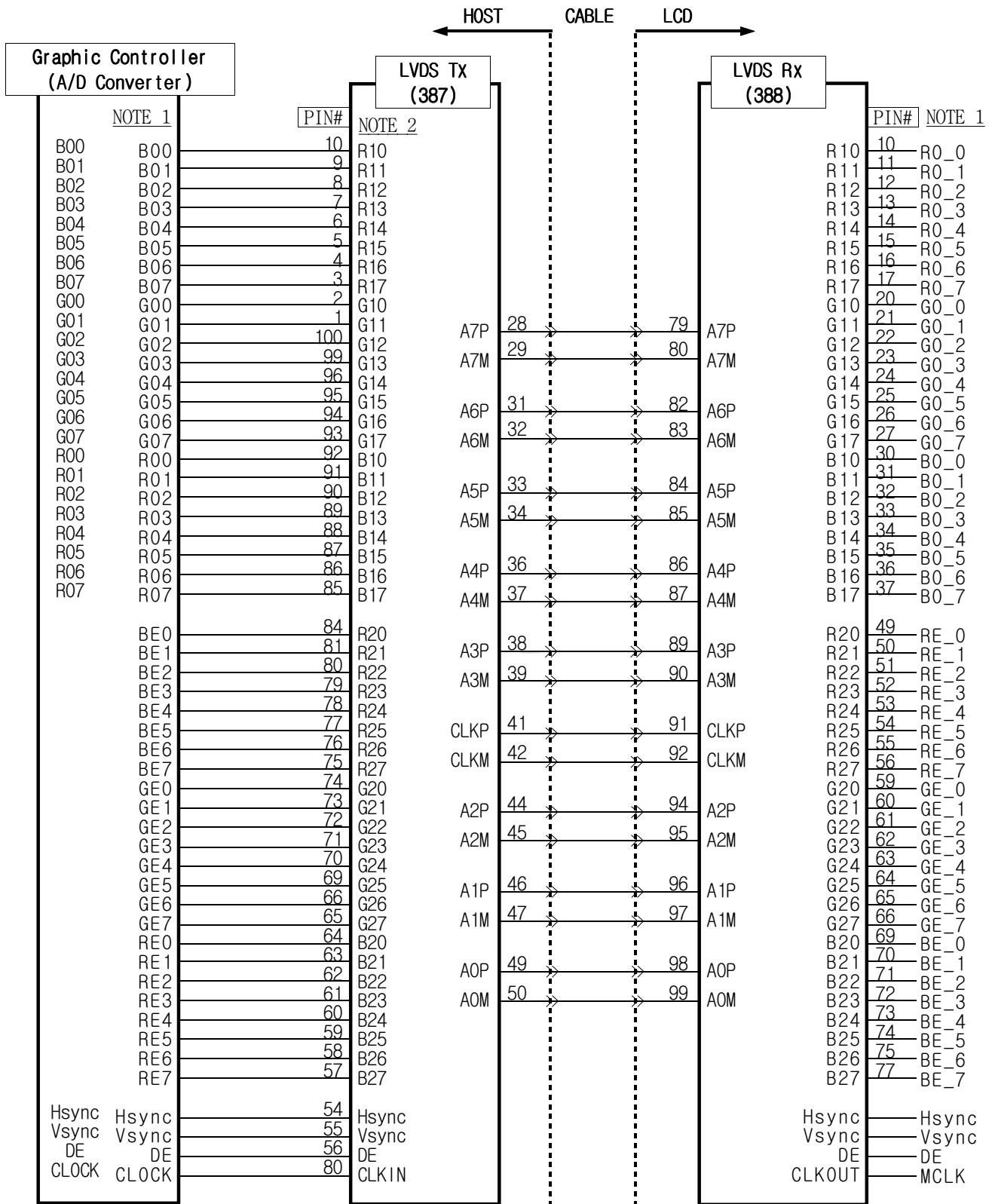


6.2 Timing diagrams of interface signal (DE only mode)



6.3 LVDS Interface

- LVDS Receiver : NS DS90CF388



NOTE 1 : SIGNAL CONFIGURATION[Graphic Controller(A/D Converter) Output]

ODD DATA(ROx, BOx, GOx : 1'st, 3'rd, 5'th data)

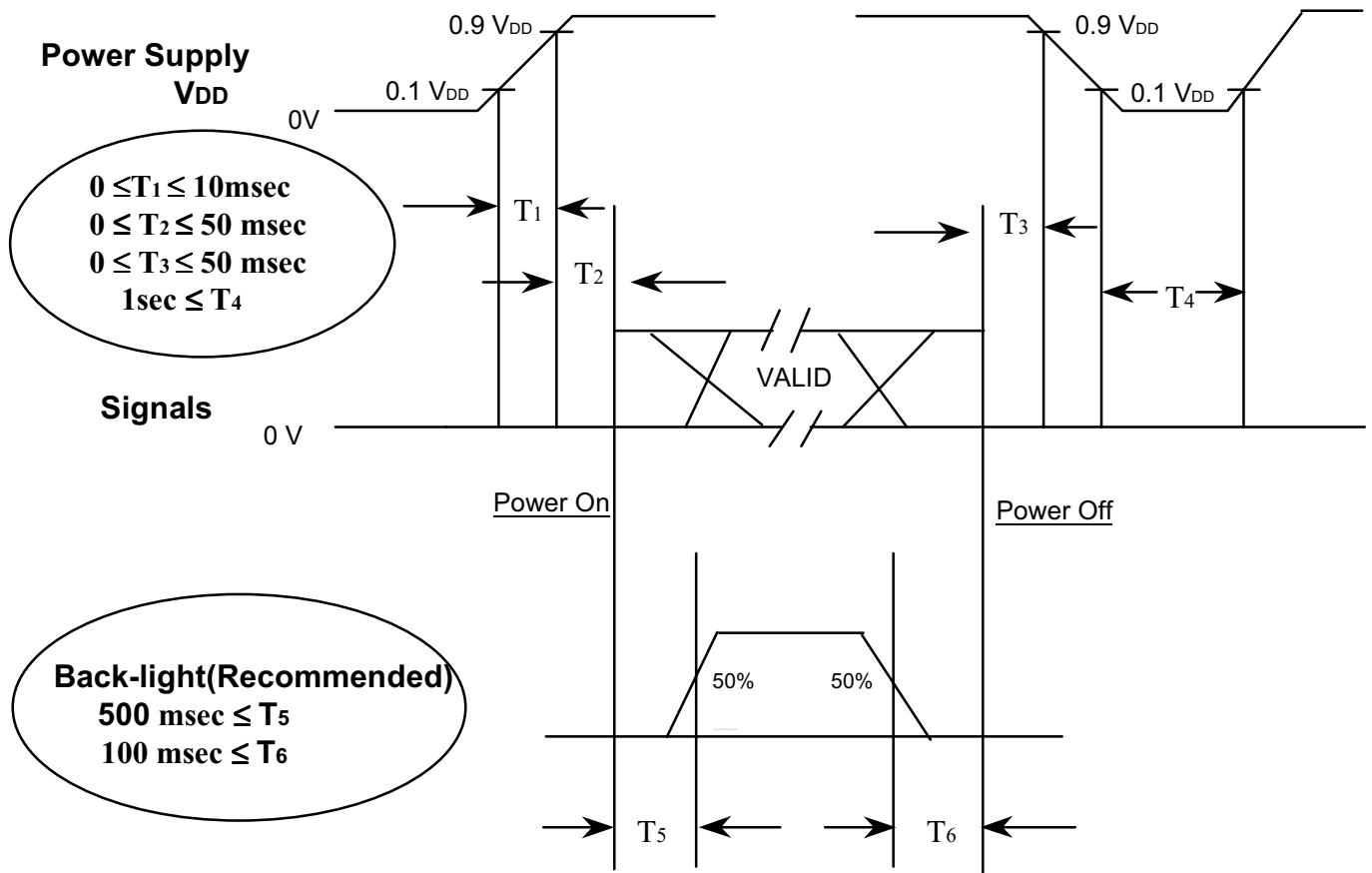
EVEN DATA(REx, GEx, BEx : 2'nd, 4'th, 6'th data)

NOTE 2 : Use FI-WE31P-HF JAE Connector on the TFT module side

Use Twisted Differential Cable(Impedence:50Ω)

6.4 Power ON/OFF Sequence

: To prevent a latch-up or DC operation of the LCD module, the power on/off sequence should follow the diagram below.

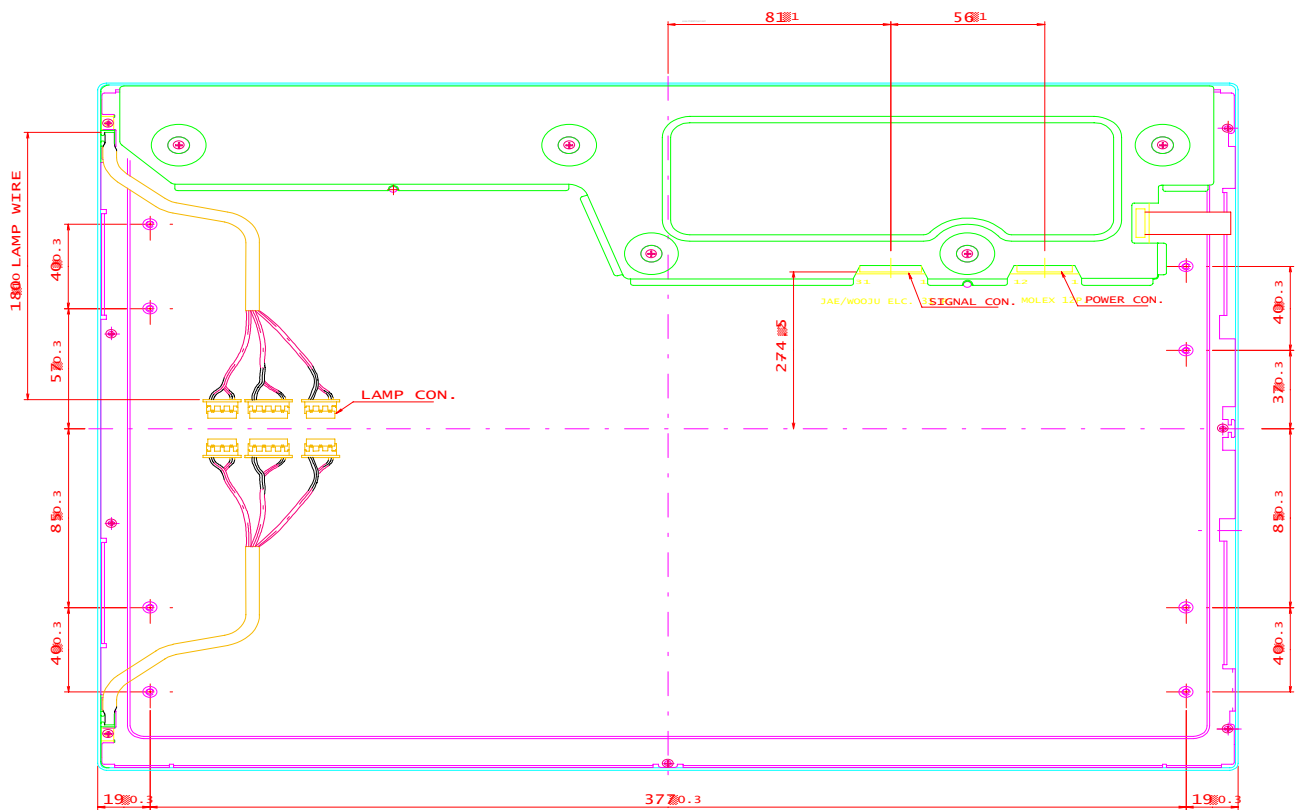
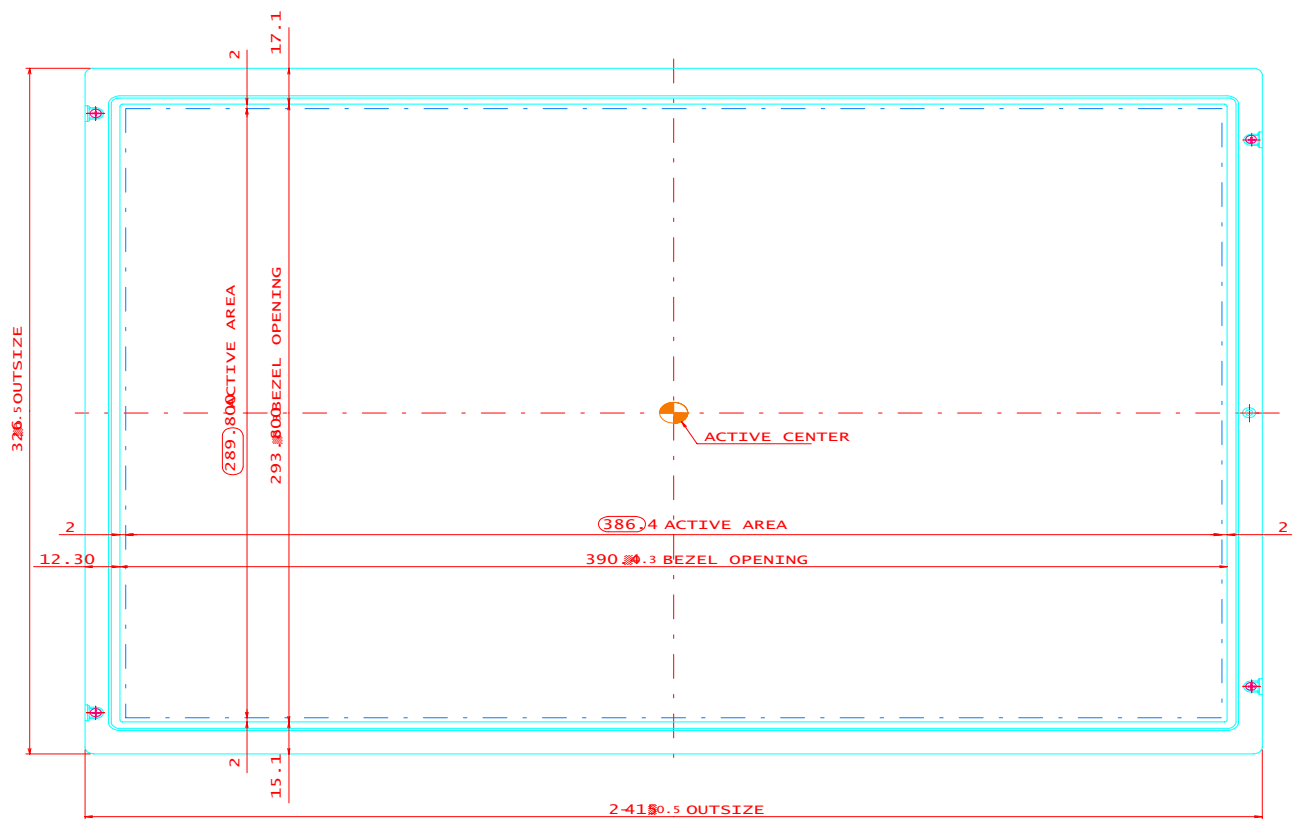


Power ON/OFF Sequence

NOTE.

- (1) The supply voltage of the external system for the module input should be the same as the definition of VDD.
- (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 does, the display may momentarily show abnormal screen.
- (3) In case of VDD = off level, please keep the level of input signals low or a high impedance.
- (4) T₄ should be measured after the module has been fully discharged between power off and on period.
- (5) Interface signal should not be kept at high impedance when the power is on.

7. Outline Dimension



8. General Precautions

8.1 Handling

- (a) When the module is assembled, it should be attached to the system firmly using every mounting hole. Be careful not to twist and bend the modules.
- (b) Refrain from strong mechanical shock and / or any force to the module. In addition to damage, this may cause improper operation or damage to the module and CCFT back-light.
- (c) Note that polarizers are very fragile and could be easily damaged. Do not press or scratch the surface harder than a HB pencil lead.
- (d) Wipe off water droplets or oil immediately. If you leave the droplets for a long time, staining and discoloration may occur.
- (e) If the surface of the polarizer is dirty, clean it using some absorbent cotton or soft cloth.
- (f) The desirable cleaners are water, IPA(Isopropyl Alcohol) or Hexane. Do not use Ketone type materials(ex. Acetone), Ethyl alcohol, Toluene, Ethyl acid or Methyl chloride. It might damage to the polarizer permanently due to chemical reaction.
- (g) The liquid crystal material leaked from the panel 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 which may cause damage to the CMOS Gate Array IC.
- (i) Use finger-stalls with soft gloves in order to keep display clean during the incoming inspection and assembly process.
- (j) Do not disassemble the module.
- (k) Do not pull or fold the lamp wire.
- (l) Do not adjust the variable resistor which is located on the module.
- (m) Protection film of the polarizer on the module should be slowly peeled off just before use in order to minimize the electrostatic charge.
- (n) Pins of I/F connector should not be touched directly with bare hands.

8.2 Storage

- (a) Do not leave the module in high temperature, 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 should be stored in a dark place. It is prohibited to apply sunlight or fluorescent light during the store.

8.3 Operation

- (a) Do neither connect nor disconnect the module in the "Power On" condition.
- (b) Power supply should always be turned on/off by the item 6.3 "Power on/off sequence"
- (c) Module has high frequency circuits. Sufficient suppression to the electromagnetic interference should be done by system manufacturers. Grounding and shielding methods may be important to minimize the interference.
- (d) The cable between the back-light connector and its inverter power supply should have a minimized length and be connected directly . The longer cable between the back-light and the inverter may cause lower luminance of lamp(CCFT) and require higher startup voltage(Vs).

8.4 Others

- (a) Ultra-violet ray filter is necessary for outdoor operation.
- (b) Avoid condensation of water which 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, and so on)
Otherwise the module may be damaged.
- (d) If the module displays the same pattern continuously for a long period of time, the situation when the image "Sticks" to the screen could happen.
- (e) This module with its circuitry PCB's on the rear side should be handled carefully in order to avoid the stress to the PCB.