SAMSUNG TFT-LCD PRODUCT INFORMATION

MODEL : LTM220MT12

Samsung Display Co., Ltd.

Contents

Revision History ---------- (3)
1. General Description ---------- (4)
2. Absolute Maximum Ratings ---------- (5)
3. Optical Characteristics ---------- (7)
4. Block diagram ---------- (13)
5. Electrical Characteristics ---------- (14)
5.1 TFT LCD Module
5.2 Back Light Unit
5.3 LVDS Input Characteristics
5.4 Timing Parameters
5.5 Input Signals, Basic Display Colors and Gray Scale of Each Color
5.6 Power ON/OFF Sequence
5.7 Input Terminal Pin Assignment
6. Outline Dimension ---------- (27)
7. Markings ---------- (28)
8. General Precautions ---------- (29)
8.1 Handling Precautions
8.2 Storage Precautions
8.3 Operation Precautions
8.4 Appendix(Set Design Guide)

Revision History

Version	Date	Page	Description
P0.0	28, JAN.,2013	All	Product information
P0.1	19, Mar.,2013	7	Color chromaticity update
P0.2	14, May,2013	4	BLU Power spec update
		16	LED spec update
P0.3	24,July,2013	5	Power Supply Voltage spec update
		17	Differential Input Voltage for LVDS receiver threshold, LVDS Skew spec update
P0.4	14, Aug, 2013	16	LED Forward Current Max spec update
P0.5	02, Sep, 2013	20	Clock Frequency Max spec update
P0.6	17, Oct, 2013	20	Timing Parameters Update (Vertical Total 1100 → 1200)
P0.7	9, Dec, 2013	7	Lenovo 向 휘도 Min Spec 212.5 추가
P0.8	20, Oct, 2014	14	Current of Power Supply update

1. General Description

Overview

LTM220MT09 is a color active matrix liquid crystal display (LCD) that uses amorphous silicon TFT (Thin Film Transistor) as switching components. This model is composed of a TFT LCD panel, a driver circuit and a back light unit. The resolution of a 22.0" is 1680 x 1050 (WSXGA+) and this model can display up to 16.7 millions colors.

Features

Application - Workstation & Desktop monitors - Display terminals for AV Products - Monitors for Industrial machine
DE (Data Enable) only mode
LVDS (Low Voltage Differential Signaling) interface (2pixel/clock)
RoHS, Halogen Free
White LED Edge slim Backlight (1-side)
TCO 6.0 compliance

General Information

Items	Specification	Unit
Pixel Pitch	0.282(H) x 0.282(W)	mm
Active Display Area	473.76(H) x 296.1(V)	mm
Surface Treatment	AG type, Haze 25% , Hard coating (3H)	-
Display Colors	16.7M (Hi-FRC)	colors
Number of Pixels	1,680 x 1,050	pixel
Pixel Arrangement	RGB vertical stripe	-
Display Mode	Normally White	-
Luminance of White	250(Typ.)	cd/㎡
Power Consumption	Total 14.5W(Typ.)(Panel 5.5W / BLU 9.0W)	W

Mechanical Information

Item		Min.	Typ.	Max.	Unit	Note
Module size	Horizontal (H)	493.2	493.7	494.2	mm	-
	Vertical (V)	319.6	320.1	320.6	mm	
	Depth (D)	9.7	10.2	10.7	mm	-
Weight		-	-	2,200	g	LCD module only

Note (1) Mechanical tolerance is ± 0.5mm unless there is a special comment

2. Absolute Maximum Ratings

If the condition exceeds maximum ratings, it can cause malfunction or unrecoverable damage to the device.

Item	Symbol	Min.	Max.	Unit	Note
Power Supply Voltage	V_{DD}	GND-0.5	6.5	V	(1)
Operating Temperature	T_{OPR}	0	50	℃	(2)
Storage temperature	T_{STG}	-20	60	℃	
Glass surface temperature (Operation)	T_{SUF}	0	65	℃	(3)
Center of Glass surface temperature (Operation)	T_{SUR}	0	50	℃	(3-1)
[A)] Shock(Non-operating)	Snop	-	50	G	(4)
[A)] Vibration(Non-operating)	Vnop	-	1.5	G	(5)

A) ONLY LCD manufacturer uses internally this item

Note (1) Ta= 25 ± 2 °C

Note (2) Temperature and relative humidity range are shown in the figure below.
a. 90 % RH Max. (Ta ≤ 40 °C)
b. Maximum wet-bulb temperature at 40 °C or less. (Ta ≤ 40 °C)
c. No condensation

(3) The maximum operating temperature of LCD module is defined with surface temperature of active area. Under any condition, the maximum ambient operating temperature should be keeping the surface of active area not any higher than 65 °C

(3-1) The maximum operating temperature of LCD module is defined with surface temperature of active area. Under any condition, the maximum ambient operating temperature should be keeping the center of glass surface (Active area) not any higher than 50 °C

(4) 11ms, 1 times for ±X, ±Y, ±Z

(5) 10-300Hz, Sweep rate:10min, 30min for X, Y, Z axis

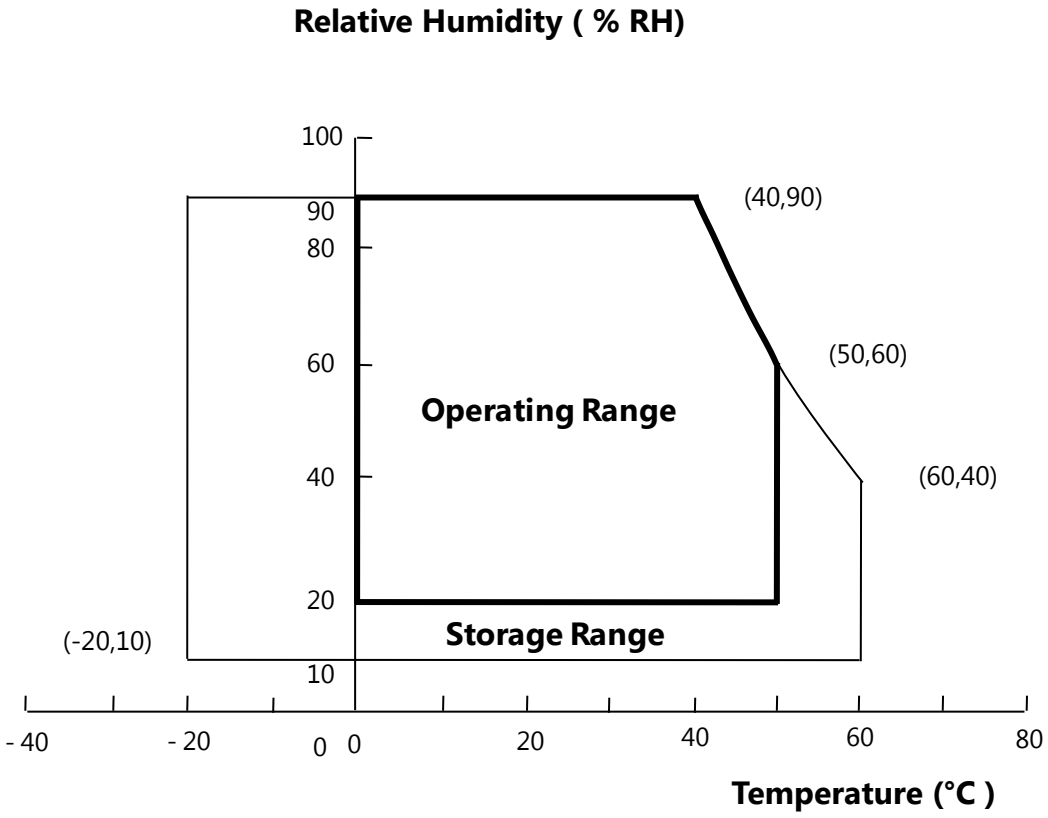


Fig. Temperature and Relative humidity range

3. Optical Characteristics

The optical characteristics should be measured in a dark room or equivalent.
Measuring equipment : SR-3, RD-80S (TOPCON), EZ-Contrast (Eldim)

(Ta = 25 ± 2°C, VDD=5V, fv= 60Hz, f_{DCLK}=59.6MHz, If =300mA)

Item		Symbol	Condition	Min.	Typ.	Max.	Unit	Note
Contrast Ratio (Center of screen)		C/R		700	1000	-		(3) SR-3
Response Time	On/Off	Tr + Tf		-	5	8	msec	(5) RD-80S
Luminance of White (Center of screen)		Y_L		200 (212.5)	250	-	cd/m^2	(6) SR-3
Brightness Uniformity 개발 : 13 Points 응기 : 9Point		B_{uni}		-	-	25	%	(4) SR-3
Color Chromaticity (CIE 1931)	Red	Rx	Normal $\theta_{L,R}$=0 $\theta_{U,D}$=0 Viewing Angle	- 0.025	0.635	+0.025		(7),(8) SR-3
		Ry			0.338			
	Green	Gx			0.334			
		Gy			0.625			
	Blue	Bx			0.156			
		By			0.044			
	White	Wx			0.313			
		Wy			0.329			
C)Color Chromaticity (CIE 1976)	Red	Ru'		-	0.439	-		
		Rv'		-	0.526	-		
	Green	Gu'		-	0.136	-		
		Gv'		-	0.572	-		
	Blue	Bu'		-	0.195	-		
		Bv'		-	0.123	-		
	White	Wu'		-	0.198	-		
		Wv'		-	0.469	-		

C) This is for customers

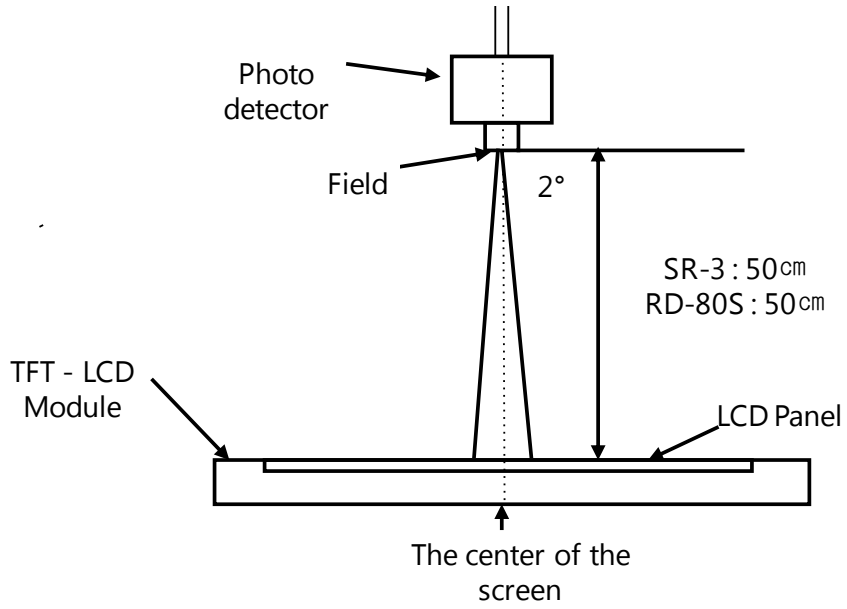
Item		Symbol	Condition	Min.	Typ.	Max.	Unit	Note
Color Gamut		-		68	72	-	%	
Color Temperature		-		-	6500	-	K	
[A)] Gamma value				1.9	2.2	2.5		
Viewing Angle	Hor.	θ_L	CR≥10 (CR≥5)	70	85	-	Degrees	(8) EZ-Contrast
		θ_R		70	85	-		
	Ver.	θ_U		70	80	-		
		θ_D		70	80	-		
[A)] Flicker		F		-	-	8		(9)
[A)] Cross Modulation		C_T		-	-	5	%	(10)

A) ONLY LCD manufacturer uses internally this item.

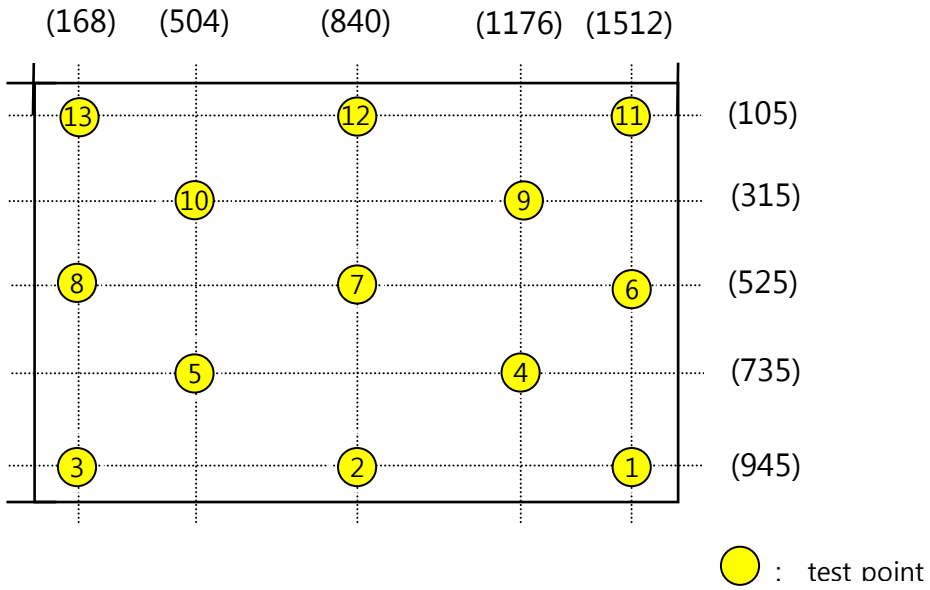
Note (1) Test Equipment Setup

The measurement should be executed in a stable, windless and dark room between 30min after lighting the back light at the given temperature for stabilization of the back light. This should be measured in the center of screen.

LED Forward current : If = 300mA Environment condition : Ta = 25 ± 2 °C



(2) Definition of test point



(3) Definition of Contrast Ratio (CR)

: Ratio of gray max (G_{max}) & gray min (G_{min}) at the center point⑦ of the panel

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

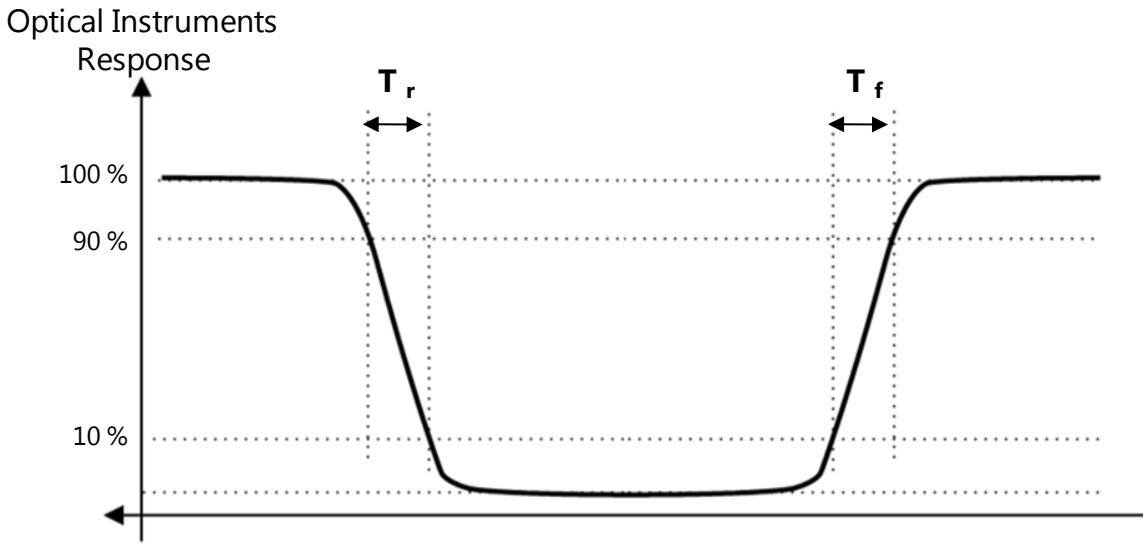
G_{max} : Luminance with all pixels white
G_{min} : Luminance with all pixels black

(4) Definition of 13 points brightness uniformity

$$B_{uni} = 100 \times \frac{B_{max} - B_{min}}{B_{max}}$$

B_{max} : Maximum brightness
B_{min} : Minimum brightness

(5) Definition of Response time : Sum of Tr, Tf



(6) Definition of Luminance of White : Luminance of white at center point⑦

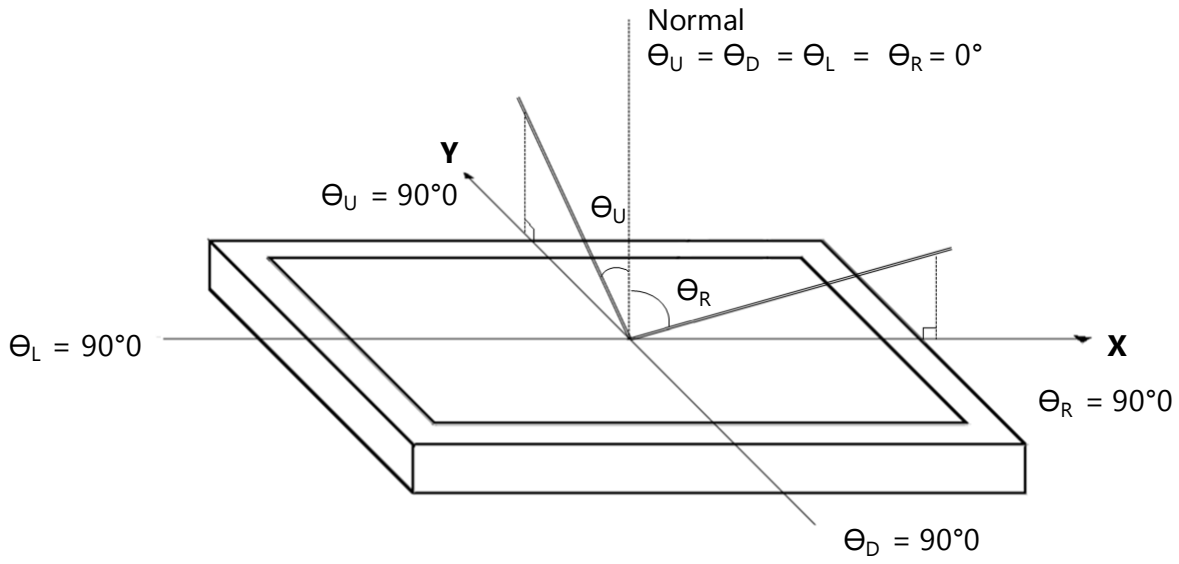
Luminance spec (Min.212.5) apply only to Lenovo

(7) Definition of Color Chromaticity (CIE 1931, CIE1976)

Color coordinate of Red, Green, Blue & White at center point⑦

(8) Definition of Viewing Angle

: Viewing angle range (CR > 10)

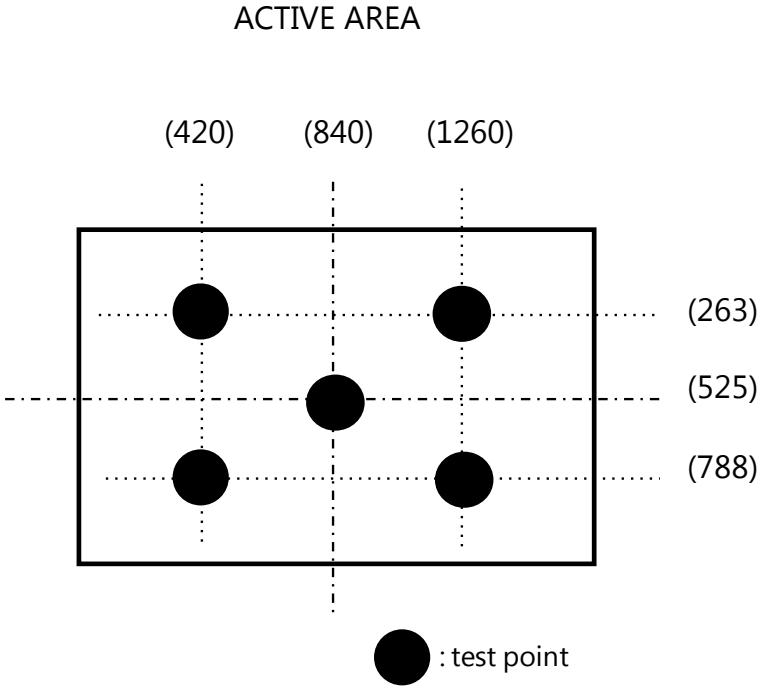


(9) Definition of Flicker

Measuring equipment :RD-80S

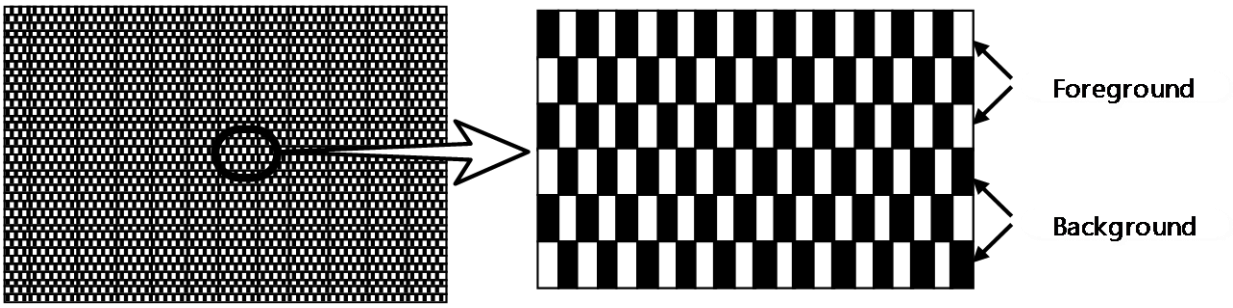
Calculation depends on the flicker measurement standards.

Measurement Point



Flicker Measurement Pattern

1 DOT inverting drive



(10) Definition of Crosstalk

Crosstalk Calculation Method

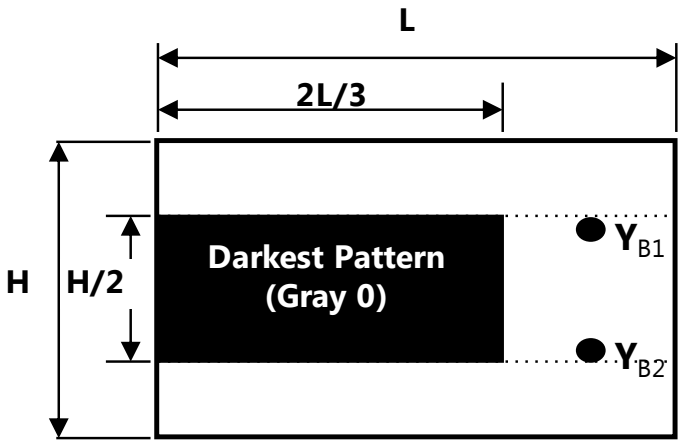
$$\text{Crosstalk Modulation Ratio}(D_{SHA}) = \frac{|Y_A - Y_B|}{Y_A} \times 100\ (\%)$$

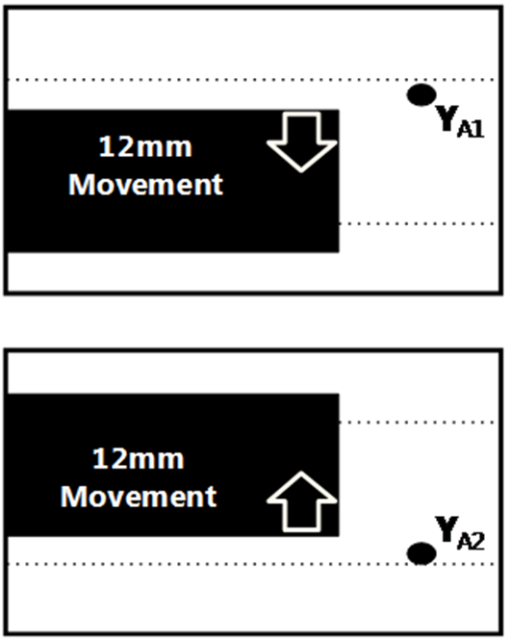
Where

Y_A, Y_B = Measurement 2°Viewing Angle (Measurement area ψ12 ㎜)

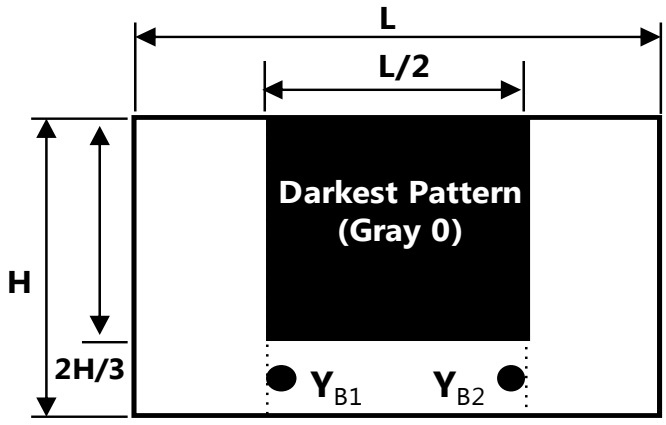
Back ground pattern except Black Bar includes 1-63 Gray ranges.

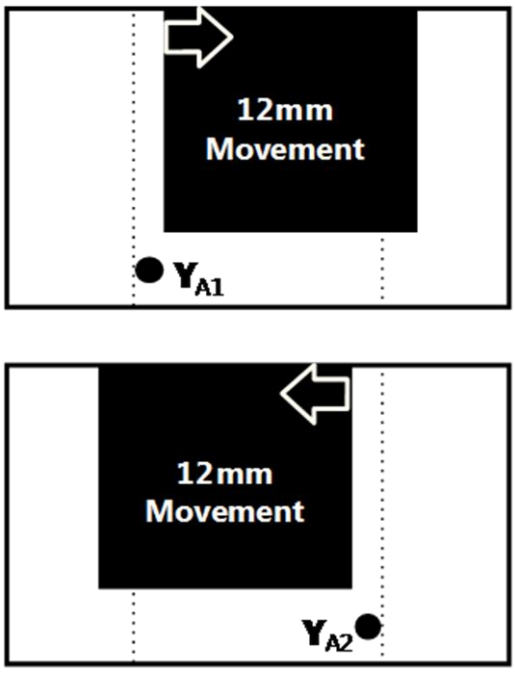
1) Horizontal-Crosstalk Measurement Method





2) Vertical-Crosstalk Measurement Method





4. Block Diagram

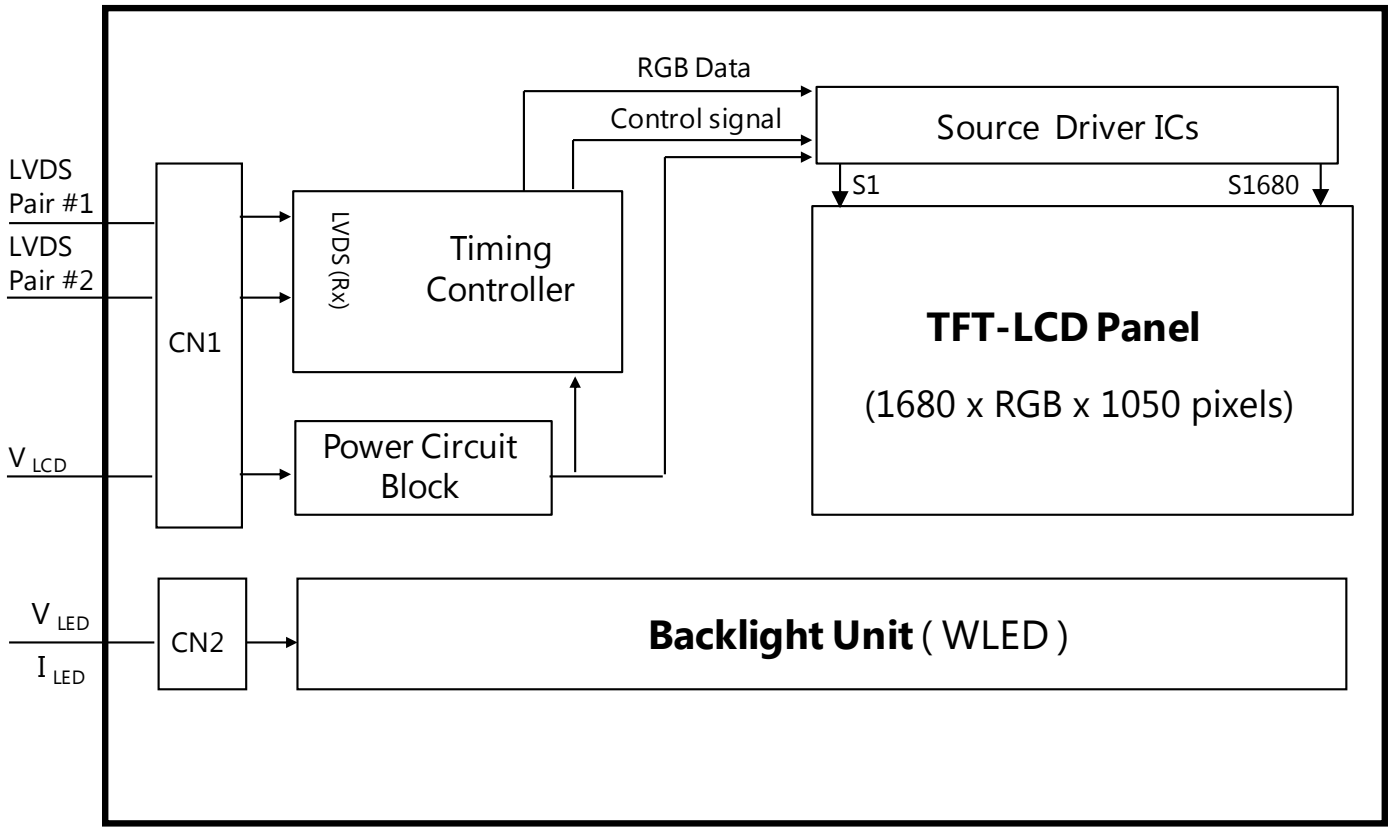


Fig. Function Block Diagram

Note (1) The connector for display data & timing signal should be connected

5. Electrical Characteristics

5.1 TFT LCD Module

The connector for display data & timing signal should be connected.

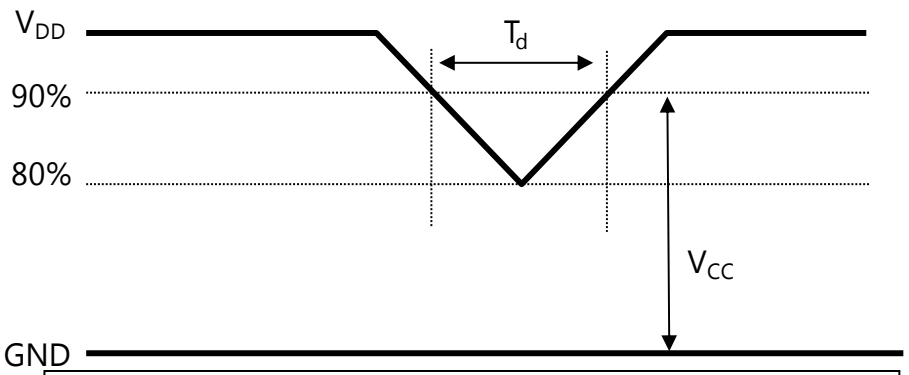
Ta=25 ± 2°C

Item		Symbol	Min.	Typ.	Max.	Unit	Note
Voltage of Power Supply		V_{DD}	4.5	5.0	5.5	V	(1)
Power Dip Condition		V_{CC}	4.0	-	V_{DD}	V	(2)
		T_d	0	-	20	msec	
Current of Power Supply	(a) White(60Hz)	I_{DD}	-	410	-	mA	(3),(4)
	(b) Black(60Hz)		-	890	-	mA	
	(c) Mosaic(60Hz)		-	650	720	mA	
	(d) Dot(60Hz)			1120	1240	mA	
	(d) Dot(75Hz)		-	1340	1480	mA	
Power Consumption		P_{LCD}	-	5.5	-	Watt	(4),(5)
Rush Current		I_{RUSH}	-	-	5.0	A	(7)

Note (1) The ripple voltage should be controlled under 10% of V_{DD}

(2) Definition of V_{DD} Power Dip

- The above conditions are for the glitch of the input voltage.
- For stable operation of an LCD Module power, please follow them.



$4.5V \le V_{DD} \le 5.5V$

If V_{DD}(Typ.) x 80% $\le V_{CC} \le V_{DD}$(Typ.) x 90%,

then 0<Td ≤20msec

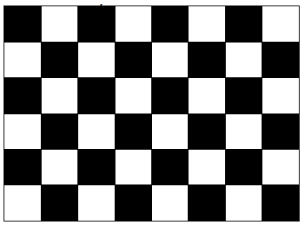
(3) f_V=60Hz, f_{DCLK} = 59.6MHz, V_{DD} = 5.0V, DC Current.
f_V=75Hz, f_{DCLK} = 78.0MHz, V_{DD} = 5.0V, DC Current.

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

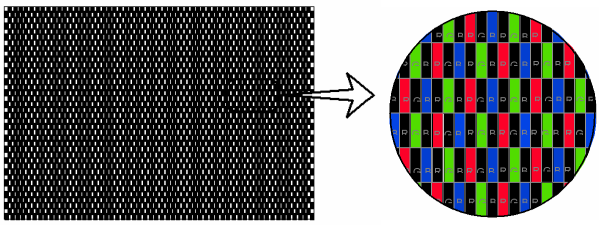
a) White Pattern

b) Black Pattern

c)Mosaic Pattern

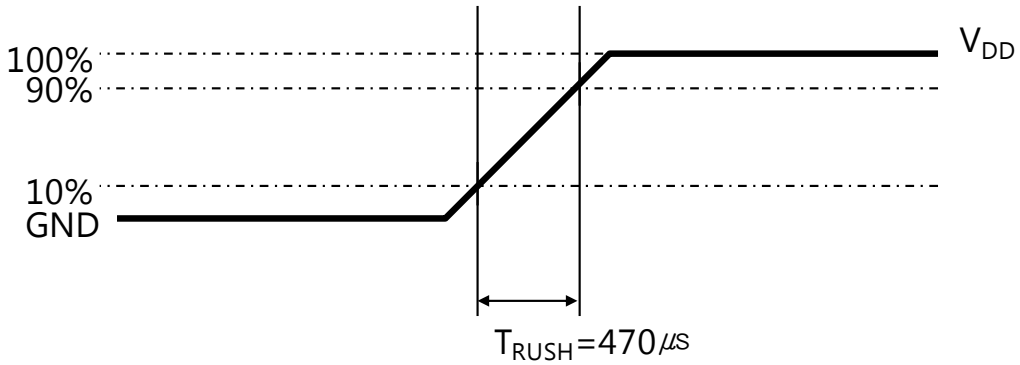


d) Dot Pattern



(5) The power consumption is specified whereas Mosaic pattern is displayed at f_V=60Hz, f_{DCLK} = 59.6MHz, V_{DD} = 5.0V

(6) Measurement Condition



Rush Current I_{RUSH} can be measured when T_{RUSH}. is 470㎲.

5.2 Backlight Unit

The characteristics of LED bar Ta=25 ± 2°C

Item	Symbol	Min.	Typ.	Max.	Unit	Note
LED Forward Current	I_F	-	300	330	mA	(1),(2)
LED Array Voltage	V_P	27.0	30.0	C)33.1	V	(1)
Power Consumption	P_{BLU}	-	9.00	-	Watt	(3)
Operating Life Time	Hr	40,000	-	-	Hour	(4)

C) This is for customers

Note (1) The above specification is not for the converter output, but for the LED bar.
- The LED bar consists of 30 LED packages ; 3 parallel X 10 serial
- LED current is defined at 100% duty ratio of LED driver

(2) The LED Forward current for single LED channel is Typ.100mA
- The output current of converter in the system should be transmitted to the LED bar constantly.
- It is recommended to control the returned signal respectively for even distribution of current to each channel of LED bar

(3) The power consumption is specified at typical current 300mA with 100% duty ratio
- It does not include power loss of external LED driver circuit block
- Typical power consumption $P_{BLU} = I_F$ (Typ.) x V_P (Typ.)

(4) Life time(Hr) is defined as the time when brightness of a LED package itself becomes 50% or less than its original value at the condition of Ta=25 ± 2°C and I_F =300mA.

5.3 LVDS Characteristics

5.3.1. LVDS Input Characteristics

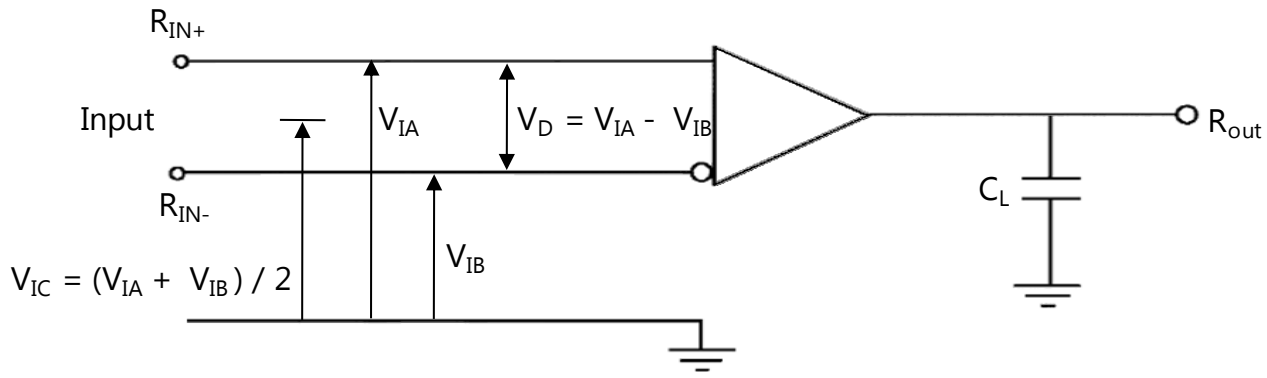
Ta=25 ± 2°C

Item	Symbol	Min.	Typ.	Max.	Unit	Note
Differential Input Voltage for LVDS receiver threshold	High	-	-	+50	mV	(1)
	Low	-50	-	-	mV	
LVDS skew	t_{SKEW}	-270	-	270	ps	(2)
Differential input voltage	$\|V_{id}\|$	100	-	600	mV	(3)
Input voltage range(single ended)	V_{in}	0.0	-	2.4	V	(3)
Common mode voltage	V_{cm}	0.4	1.2	2.9	V	(3)

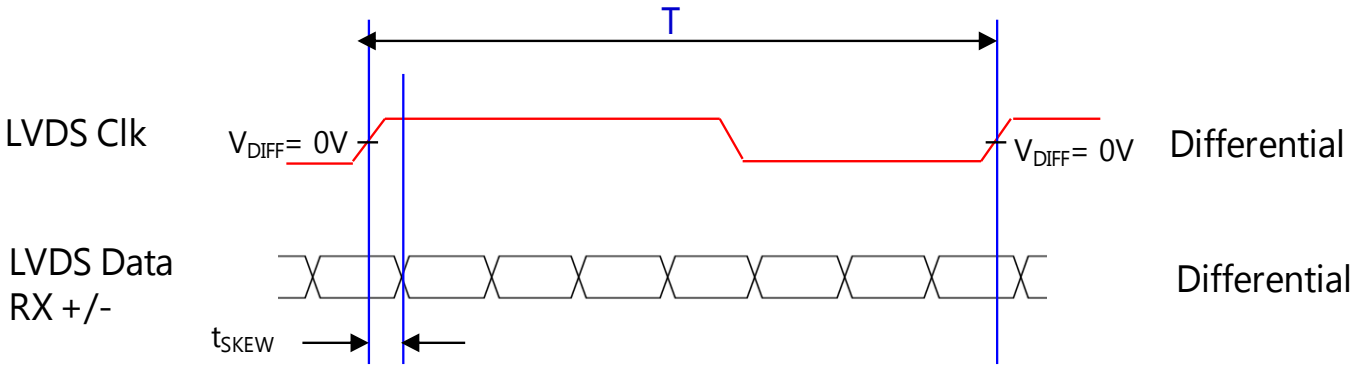
Note (1) Differential receiver voltage definitions and propagation delay and transition time test circuit

a. All input pulses have frequency = 10MHz, t_R or t_F =1ns

b. C_L includes all probe and fixture capacitance

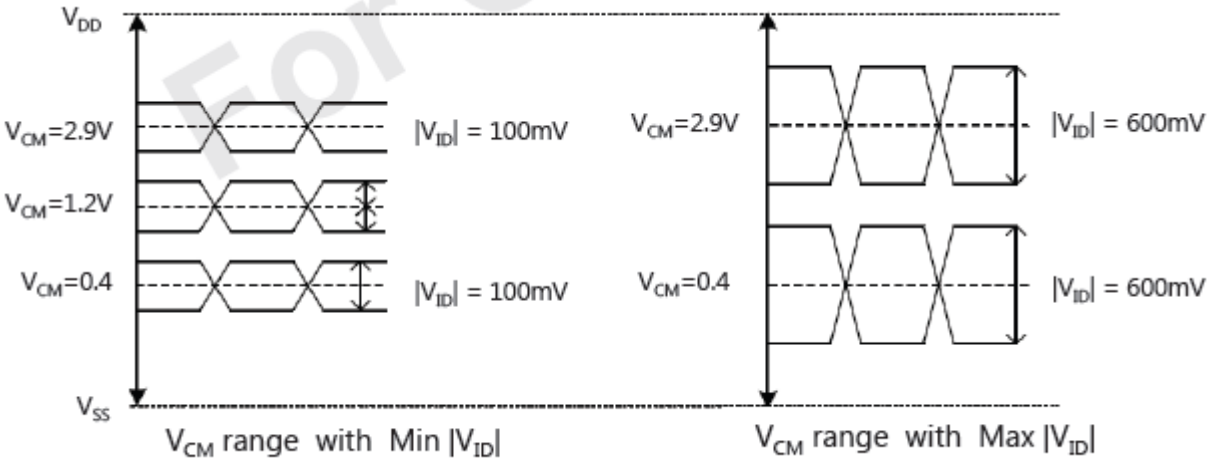


(2) LVDS Receiver DC parameters are measured under static and steady conditions which may not be reflective of its performance in the end application.



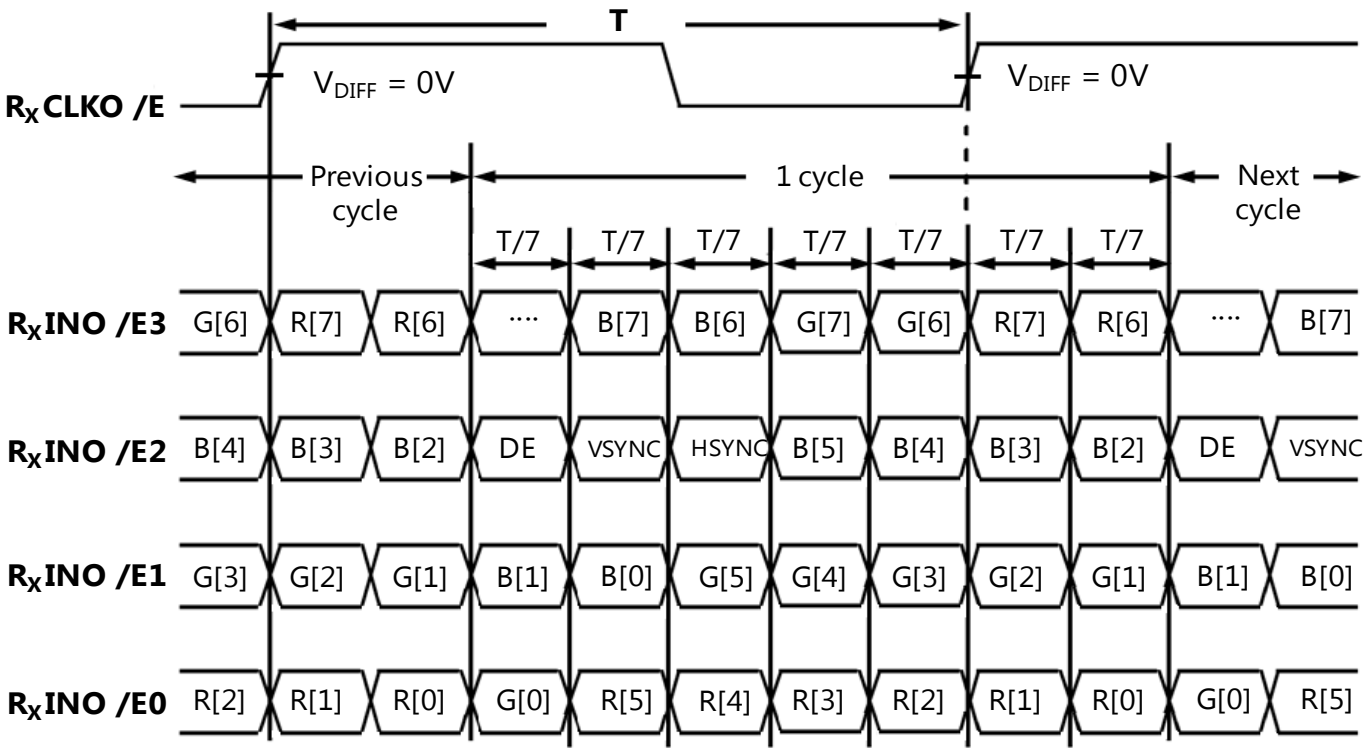
where t_{SKEW} : skew between LVDS clock & LVDS data,
T : 1 period time of LVDS clock
cf. (-/+) of 300psec means LVDS data goes before or after LVDS clock

(3) Definition of V_{ID} and V_{CM} using single-end signals



5.3.2 LVDS Data format

Timing Diagrams of LVDS For Transmitting
- LVDS Receiver : Integrated T-CON



5.4 Interface Timing Specification

5.4.1 Timing Parameters

SIGNAL	ITEM	SYMBOL	Min.	Typ.	Max.	Unit	Note
Clock	Frequency	$1/T_C$	49.68	59.6	78.0	MHz	-
Hsync		F_H	54.0	64.8	83.2	kHz	-
Vsync		F_V	50	60	77	Hz	-
Vertical Display Term	Active Display Period	T_{VD}	1050	1050	1050	Lines	-
	Vertical Total	T_V	1059	1080	1200	Lines	-
Horizontal Display Term	Active Display Period	T_{HD}	840	840	840	Clocks	2pixel/clock
	Horizontal Total	T_H	913	920	1004	clocks	2pixel/clock

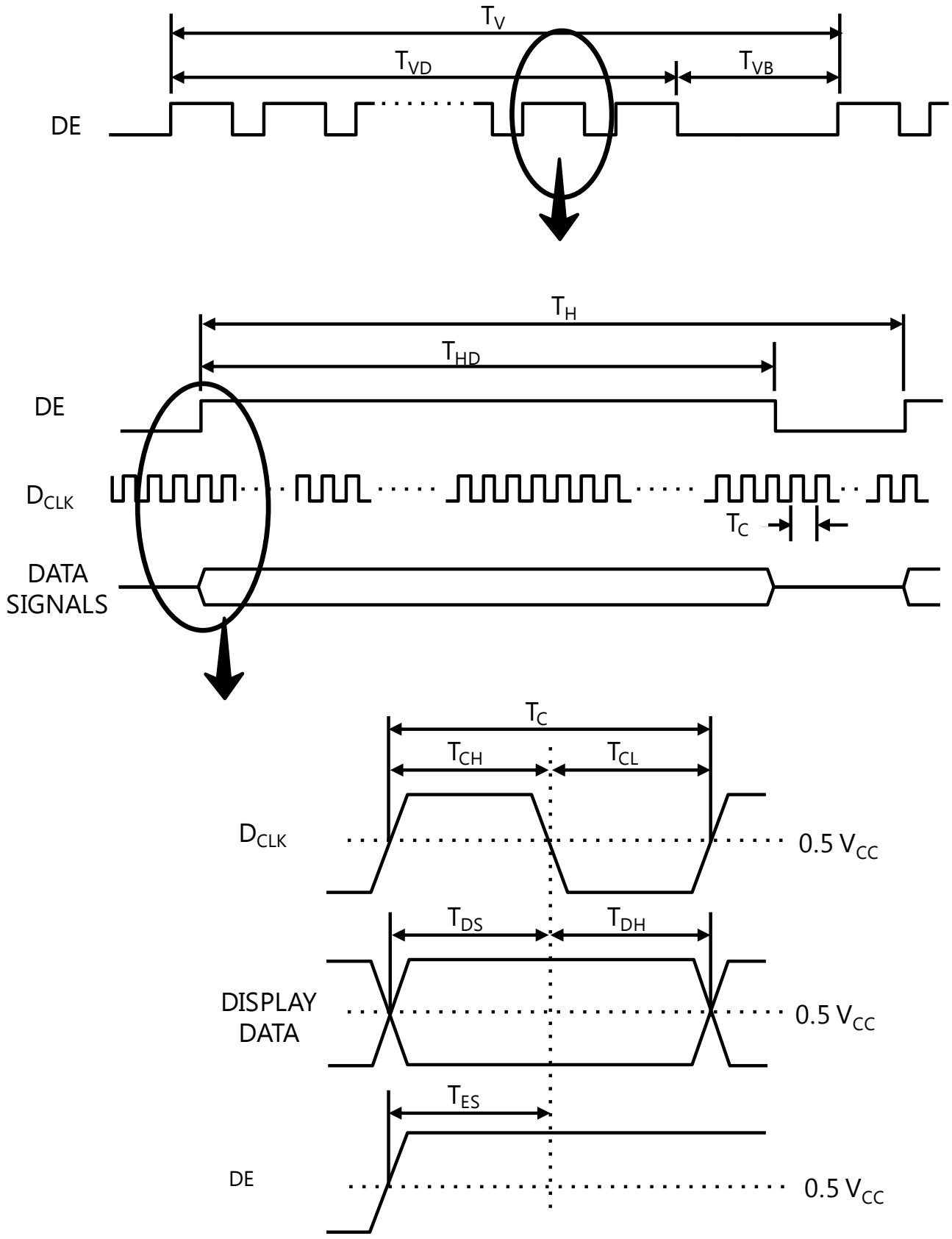
Note (1) DE only mode
- While operation, DE signal should be have the same cycle.

(2) Best operation clock frequency is 59.6MHz(60Hz)

(3) Max, Min variation range is at main clock typical value (59.6MHz)

(4) Main frequency Max is 78.0MHz without spread spectrum

5.4.2 Timing diagrams of interface signal (DE only mode)



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

COLOR	DISPLAY (8bit)	DATA SIGNAL																								GRAY SCALE LEVEL
		RED								GREEN								BLUE								
		R0	R1	R2	R3	R4	R5	R6	R7	G0	G1	G2	G3	G4	G5	G6	G7	B0	B1	B2	B3	B4	B5	B6	B7	
BASIC COLOR	BLACK	0	0	0	0	0	0	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	0	0	0	0	1	1	1	1	1	1	1	1	-
	GREEN	0	0	0	0	0	0	0	0	1	1	1	1	1	1	1	1	0	0	0	0	0	0	0	0	-
	CYAN	0	0	0	0	0	0	0	0	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	-
	RED	1	1	1	1	1	1	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	-
	MAGENTA	1	1	1	1	1	1	1	1	0	0	0	0	0	0	0	0	1	1	1	1	1	1	1	1	-
	YELLOW	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	0	0	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	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	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	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	0	0	0	0	0	0	R2
		:	:	:	:	:	:			:	:	:	:	:	:			:	:	:	:	:	:			. . .
	↓ LIGHT	1	0	1	1	1	1	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	R253
		0	1	1	1	1	1	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	R254
	RED	1	1	1	1	1	1	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	R255
GRAY SCALE OF GREEN	BLACK	0	0	0	0	0	0	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	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	G1
		0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	G2
		:	:	:	:	:	:			:	:	:	:	:	:			:	:	:	:	:	:			. . .
	↓ LIGHT	0	0	0	0	0	0	0	0	1	0	1	1	1	1	1	1	0	0	0	0	0	0	0	0	G253
		0	0	0	0	0	0	0	0	0	1	1	1	1	1	1	1	0	0	0	0	0	0	0	0	G254
	GREEN	0	0	0	0	0	0	0	0	1	1	1	1	1	1	1	1	0	0	0	0	0	0	0	0	G255
GRAY SCALE OF BLUE	BLACK	0	0	0	0	0	0	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	0	0	0	0	1	0	0	0	0	0	0	0	B1
		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	B2
		:	:	:	:	:	:			:	:	:	:	:	:			:	:	:	:	:	:			. . .
	↓ LIGHT	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	1	1	1	1	1	1	B253
		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1	1	1	1	1	1	B254
	BLUE	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1	1	1	1	1	1	1	B255

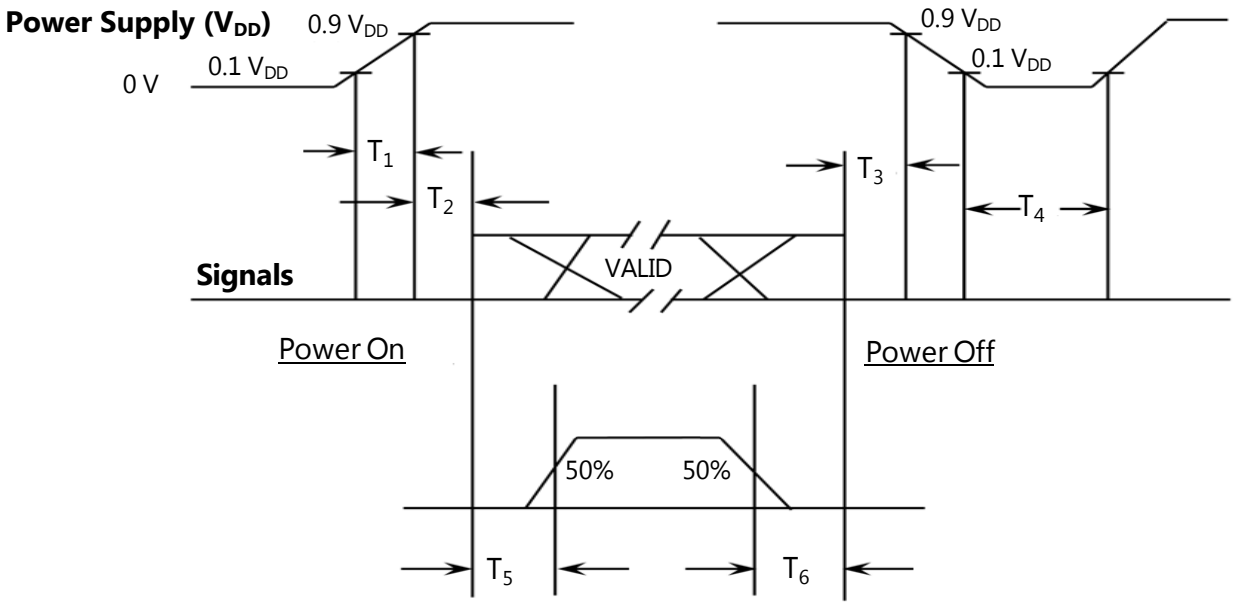
Note (1) Definition of Gray

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

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

5.6 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.



SYMBOL	Min.	Typ.	Max.	Unit	Description
T_1	0	-	10	ms	V_{DD} rising time from 10% to 90%
T_2	0	-	50	ms	The time from V_{DD} to valid data at power ON
T_3	0	-	50	ms	The time from valid data off to V_{DD} off at power Off
T_4	1	-	-	s	V_{DD} off time for Windows restart
T_5	500	-	-	ms	The time from valid data to B/L enable at power ON
T_6	100	-	-	ms	The time from valid data off to B/L disable at power Off

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 BLU power 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 show abnormal screen.

(3) In case of V_{DD} = off level, please keep the level of input signals 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 should not be kept at high impedance when the power is on.

5.7 Input Terminal Pin Assignment

5.7.1 Input signal & Power Pin Assignment

Connector : UJU IS100-L30B-C23 or equivalent

Pin No.	Symbol	Function
1	RXO0N	Negative Transmission Data of Pixel 0 (ODD data)
2	RXO0P	Positive Transmission Data of Pixel 0 (ODD data)
3	RXO1N	Negative Transmission Data of Pixel 1 (ODD data)
4	RXO1P	Positive Transmission Data of Pixel 1 (ODD data)
5	RXO2N	Negative Transmission Data of Pixel 2 (ODD data)
6	RXO2P	Positive Transmission Data of Pixel 2 (ODD data)
7	GND	Power Ground
8	RXOC-	Negative Sampling Clock (ODD data)
9	RXOC+	Positive Sampling Clock (ODD data)
10	RXO3N	Negative Transmission Data of Pixel 3 (ODD data)
11	RXO3P	Positive Transmission Data of Pixel 3 (ODD data)
12	RXE0N	Negative Transmission Data of Pixel 0 (EVEN data)
13	RXE0P	Positive Transmission Data of Pixel 0 (EVEN data)
14	GND	Power Ground
15	RXE1N	Negative Transmission Data of Pixel 1 (EVEN data)
16	RXE1P	Positive Transmission Data of Pixel 1 (EVEN data)
17	GND	Power Ground
18	RXE2N	Negative Transmission Data of Pixel 2 (EVEN data)
19	RXE2P	Positive Transmission Data of Pixel 2 (EVEN data)
20	RXEC-	Negative Sampling Clock (EVEN data)
21	RXEC+	Positive Sampling Clock (EVEN data)
22	RXE3N	Negative Transmission Data of Pixel 3 (EVEN data)
23	RXE3P	Positive Transmission Data of Pixel 3 (EVEN data)
24	GND	Power Ground
25	NC	* Reserved for LCD manufacturer's use (CE_DVR)
26	NC	* Reserved for LCD manufacturer's use (CTL_DVR)
27	NC	No Connection
28	VDD	Power Supply : +5V
29	VDD	
30	VDD	

Note (1) If the system already uses the 25, 26pins, it should keep under GND level
The voltage applied to those pins should not exceed -200mV.

Note (2) Pin number starts from Left side

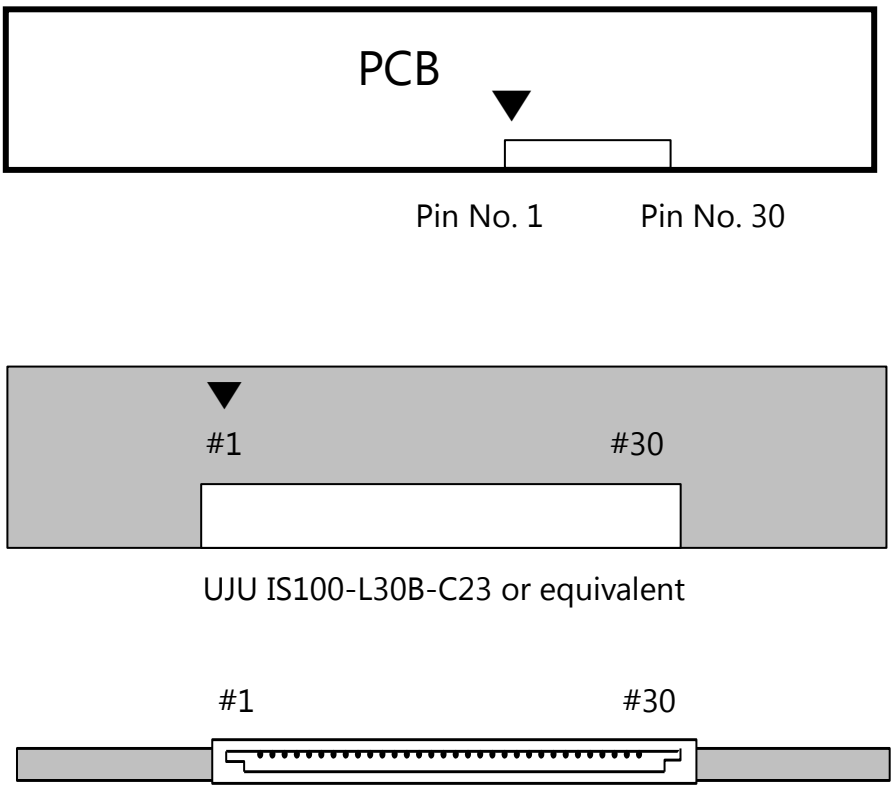


Fig. Connector diagram

Note (3) All GND pins should be connected together and also be connected to the LCD's metal chassis.

(4) All power input pins should be connected together.

(5) All NC pins should be separated from other signal or power

5.7.2 LED Connector Pin assignment

Connector : Molex 104086-0410 pr equivalent

- The mating type connector : Molex 104085-0400 or equivalent

Pin No.	Symbol	Function
1	Vin	LED power input
2	RTN 1	Channel 1 LED return
3	RTN 2	Channel 2 LED return
4	RTN 3	Channel 3 LED return

Note (1) Pin number starts from Left side

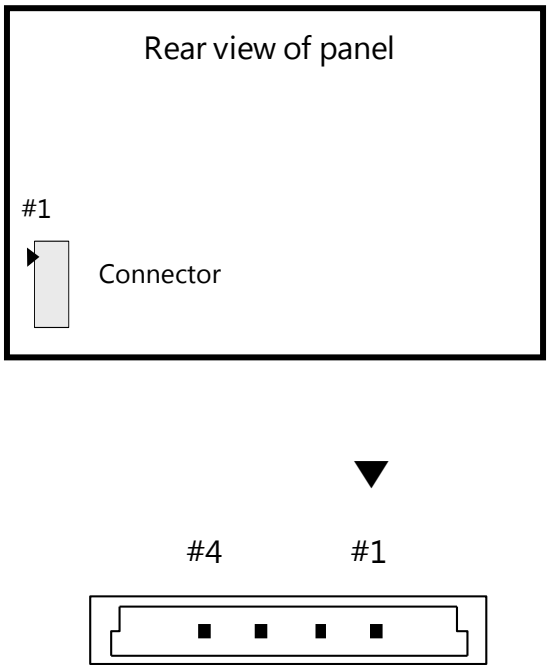
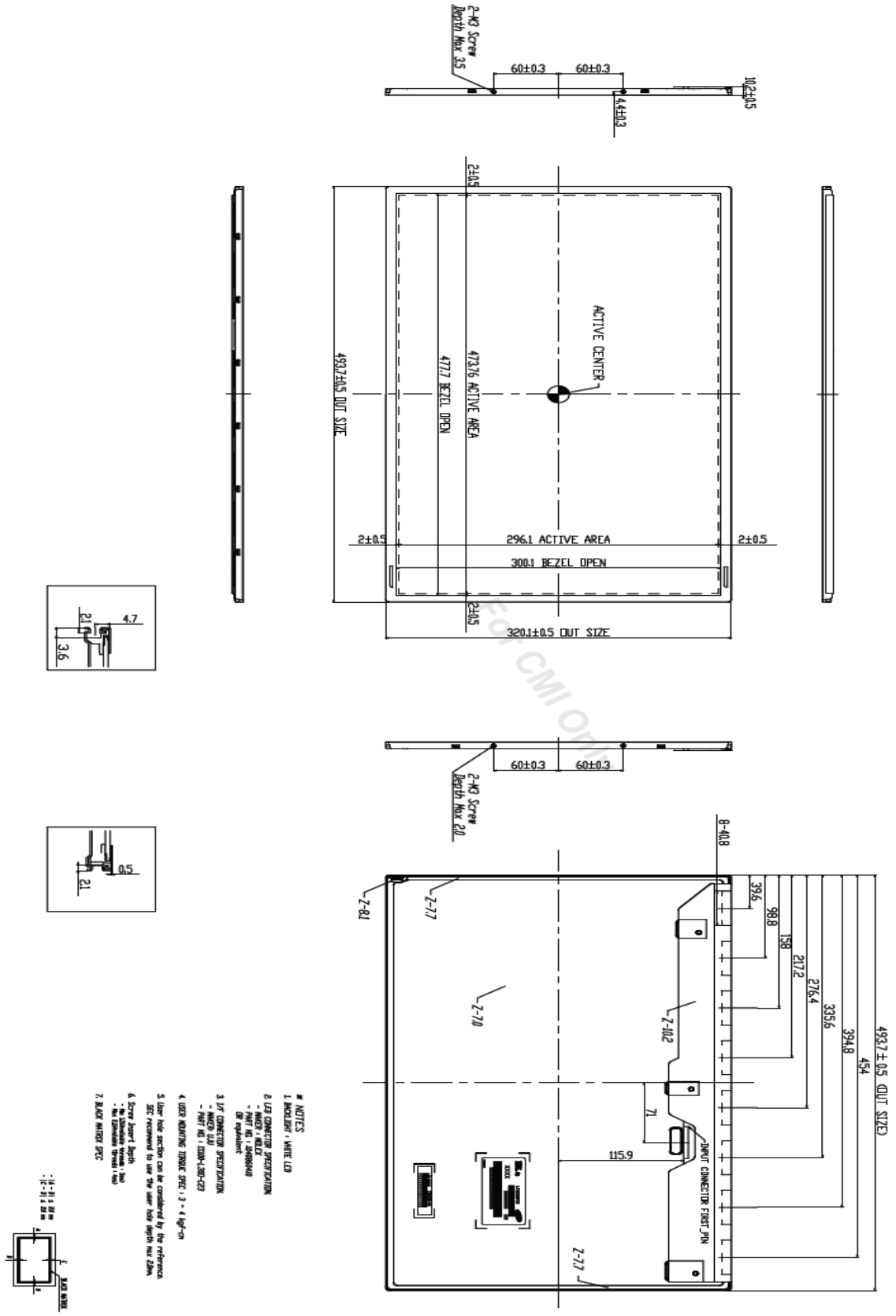


Fig. Connector diagram

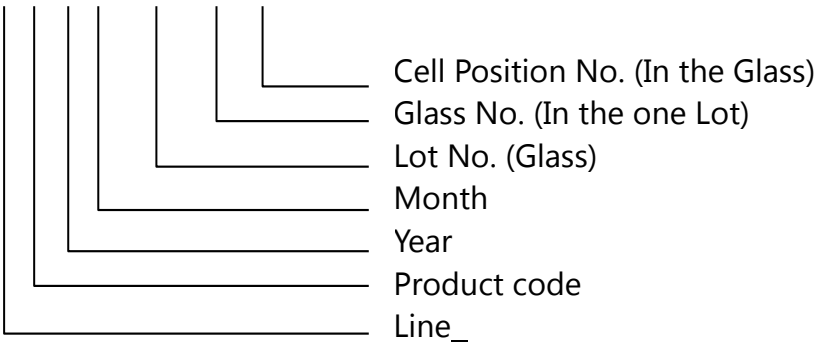
6. Outline Dimension



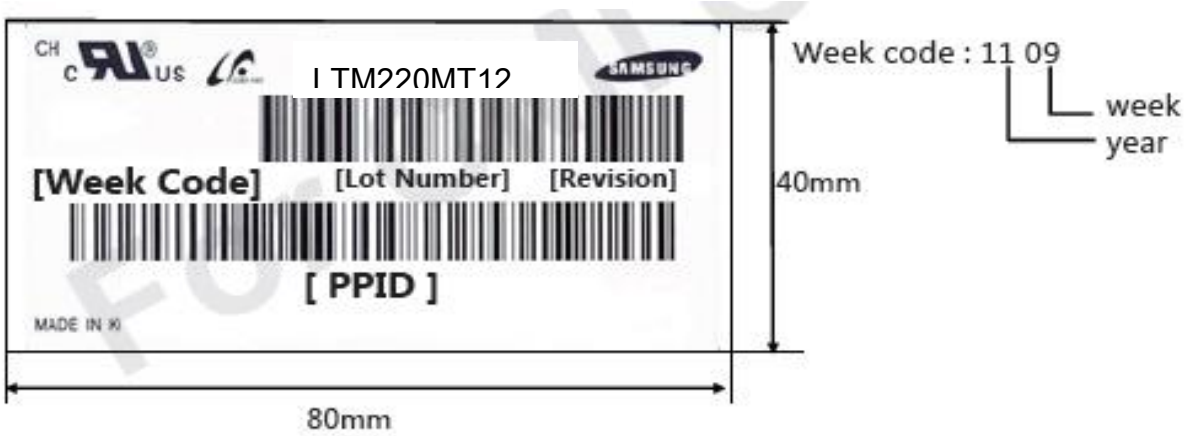
7. Marking

A nameplate bearing followed by is affixed to a shipped product at the specified location on each product.

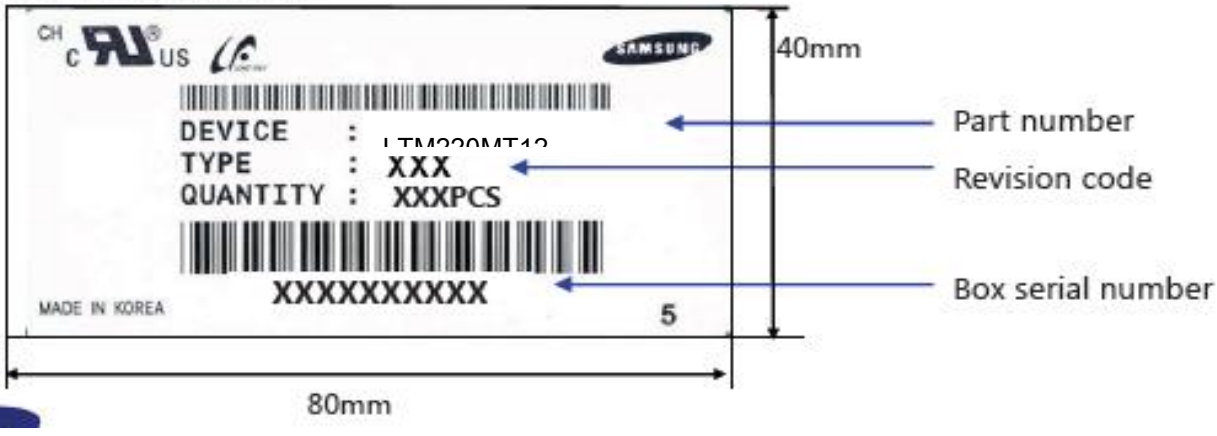
(1) Parts number : LTM220MT12
(2) Revision: Three letters
(3) Lot number : X X X X XXX XX X



(4) Nameplate Indication



(4) Packing box attach



8. General Precautions

8.1 Handling Precautions

A. When assembling LCD module into its system, using all the mounting holes is strongly suggested.

B. Keep LCD module from any external shock or force which can cause physical damage to LCD module. It may cause improper operation or damage to LCD module.

C. Polarizer films are very fragile. It could be damaged easily. Do not press or scratch the surface harder than a HB pencil lead.

D. Wipe off water droplets or oil immediately. Water drops or oils can cause permanent stain or discoloration.

E. To clean LCD module, please use IPA (Isopropyl Alcohol) or Hexane.

F. Do not use ketone type material (ex. Acetone), ethyl alcohol, toluene, ethyl acid or methyl chloride. Using these could cause permanent polarizer damage to the LCD module.

G. If the liquid crystal leaks from LCD module, keep it away from human eyes or mouth. In case of contact with human body or clothes, it should be washed with soap thoroughly.

H. Protect LCD module from static discharge.

I. To keep the LCD module clean, make sure to wear fabric gloves and finger coats when you are inspecting and/or assembling the unit.

J. Do not disassemble LCD module.

K. Protection film on LCD module display area should be slowly peeled off just before assembly to prevent static discharge.

L. Pins of the Interface connector should not be touched directly with bare hands.

M. Any foreign materials brought into an LCD module by external forced-airflow are not guaranteed by SAMSUNG

8.2 Storage Precautions

It is highly recommended to comply with the criteria in the table below

Item	Unit	Min.	Max.
Storage Temperature	(℃)	5	40
Storage Humidity	(%rH)	35	75
Storage life	12 months		
Storage Condition	- The storage room should provide good ventilation and temperature Control . - Products should not be placed on the floor, but on the Pallet away from a wall . - Prevent products from direct sunlight, moisture nor water; Be cautious of a build up of condensation. - Avoid other hazardous environment while storing goods. - If products delivered or kept in conditions of over the storage period of 3 months, the recommended temperature or humidity range, it is recommended to leave them at a temperature of 20℃ and a humidity of 50% for 24 hours.		

8.3 Operating Precautions

A. If the module is used to other applications besides the recommendation on General Description, please contact SAMSUNG for application engineering device in advance

B. Do not connect or disconnect the LCD module when it is set to the “Power On” condition.

C. Input power should always follow ‘5.6 Power on/off sequence’

D. Polarizer films are very fragile. It could be damaged easily. Do not press or scratch the Polarizer films

E. LCD module contains electrical circuits that operate in high frequencies. To minimize electromagnetic interference, be sure to sufficiently ground and shield the LCD module and system.

F. If LCD module containing system is out of SAMSUNG ‘s operating condition, SAMSUNG can not guarantee LCD module operating properly.

G. If the product will be used in extreme conditions such as high temperature, humidity, display patterns, operation time, etc., it is strongly recommended to contact SAMSUNG for application engineering device. Otherwise, the reliability and function of the module may not be guaranteed. Extreme conditions are commonly found at airports, transit stations, banks, stocks, markets, and controlling systems.

H. Ultra-violet ray filter is necessary for outdoor operation.

I. If the module keeps displaying the same pattern for a long period of time, the image maybe burned in to the screen. To avoid image retention, it is recommended to use a screen saver.

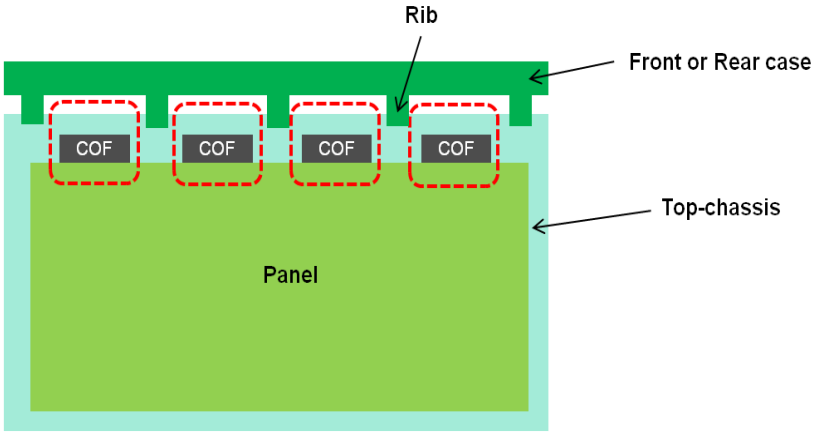
J. This module has its PCB’s circuitry on the rear side and should be handled carefully in order to avoid stress.

K. Please contact SAMSUNG beforehand, if you plan to display the same pattern for a long period of time.

L. Any foreign materials brought into an LCD module by external forced-airflow are not guaranteed by SAMSUNG .

8.4 Design Guide for System

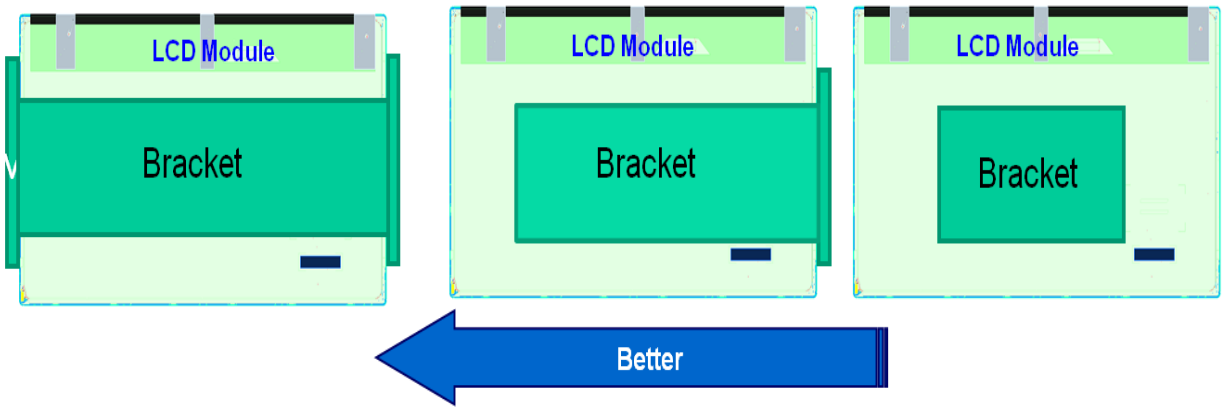
A. It is recommended that you locate the rib on the front or rear cover not to be placed on the spot where D-IC is located on the upper or left of LCD module.



B. It is recommended that assemble the bracket which has two sides with holes for assembly.

C. It is recommended that you design the bracket with the structure which covers the sides of module when designing the bracket for customer.

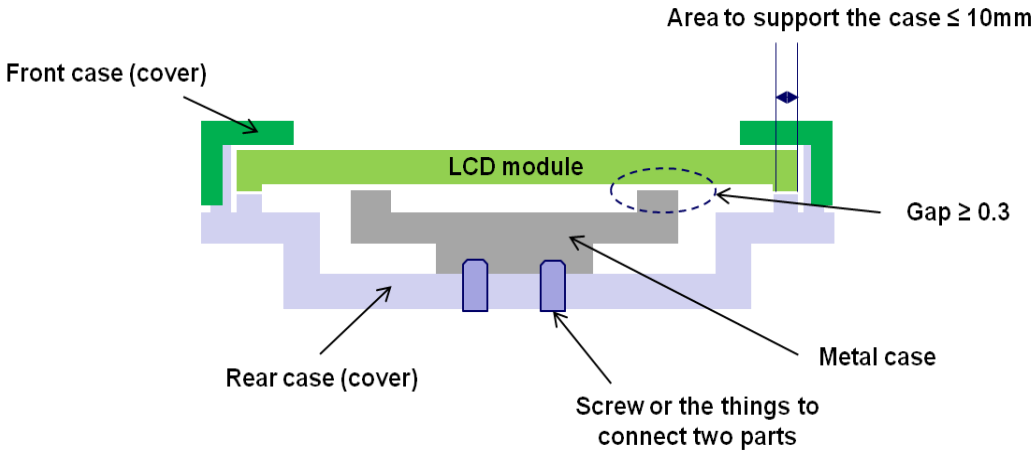
D. It is recommended that you design the bracket not to be interfered with the SET at the area where the PBA of module is located.



E. It is recommended that more than 0.3 mm is allowable as a gap between the metal case and the rear of module.

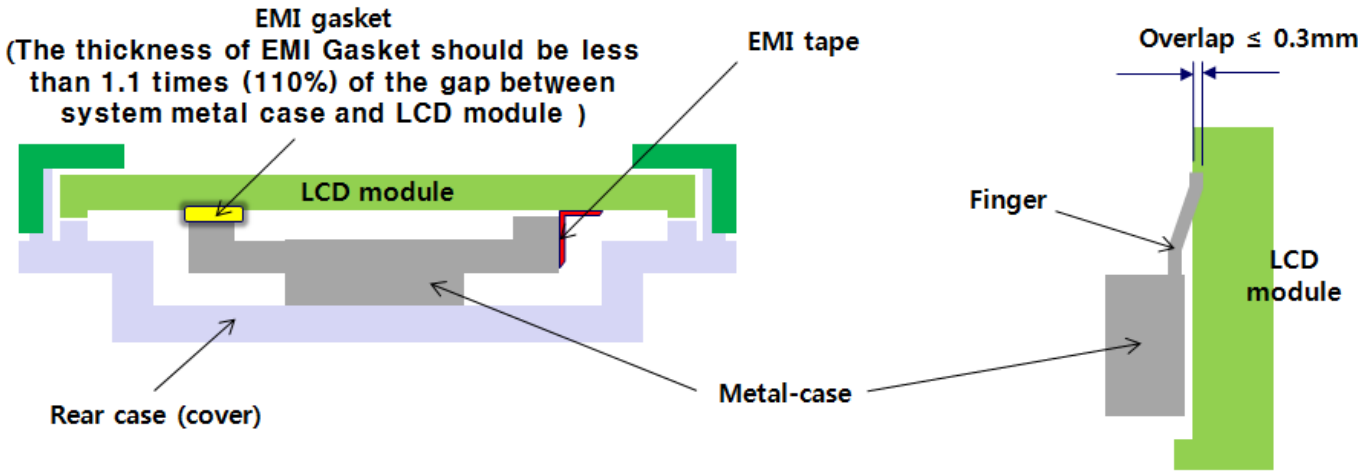
F. It is recommended that structure to support the module shall be far away 10mm from the edge of border.

G. It is recommended that metal case (or board) shall be affixed to the rear case at the spot where is far away 10mm from the edge of border.



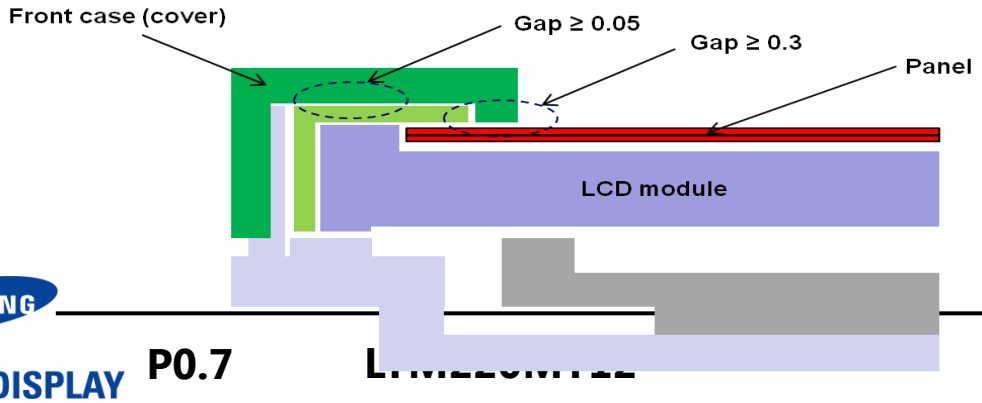
H. When applying the measures described below to reduce the level of EMI which occurs between the metal cover and the rear of module.

I. If you use Finger, less than 0.3mm is allowable for overlap.

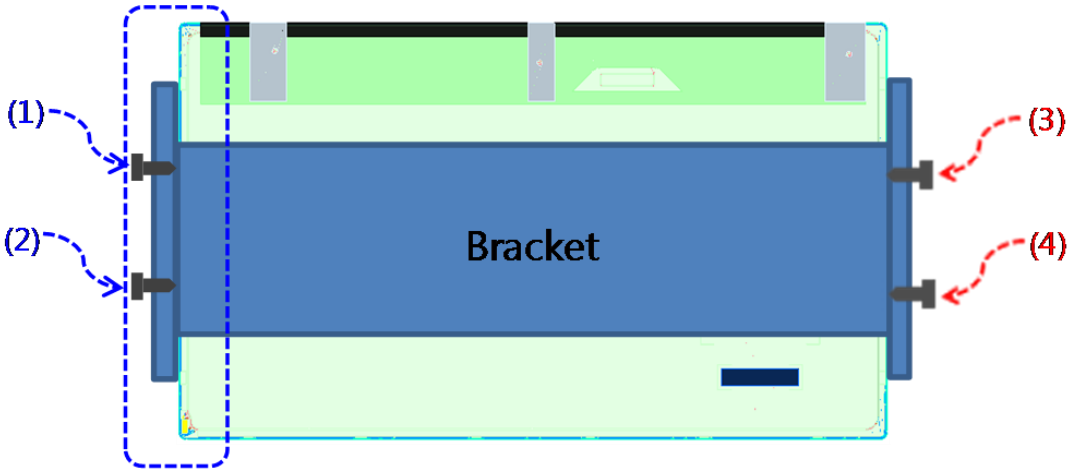


J. It is recommended that more than 0.3mm gap between the front case (or cover) and the panel glass is allowable.

K. It is recommended that more than 0.05mm gap between the front case and the top chassis is allowable.



L. It is recommended that insert the screws into user holes from the ones on the parts, which the light comes out to ones in the corresponding parts.



M. It is recommended that design the metal frame and the top chassis to be in parallel with having no gap after inserting the side screw.