SAMSUNG DISPLAY

PRODUCT SPECIFICATION

(√) PRODUCT INFORMATION
( ) APPROVAL SPECIFICATION

This is Product Information is subject to change after 3 months of issuing date

CUSTOMER	
PROGRAM	-

MODEL	LTM236FL01
EXTENSION CODE	-

CUSTOMER APPROVAL & FEEDBACK

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PREPARED BY	12 / Mar. / '14	Dongjin Shin	

Customer Support Engineering Group

Samsung Display Co., Ltd.

Product Configuration Approval Sheet

Description

Items	Content
Customer	Wistron
Product Name	LTM236FL01
Project Name	-
Spec No.	TPD02191-000

Customer System Configuration

Items		Content
System Name		-
Purpose		-
IC	Scalar	-
	LED Driver	-
Input Interface		-
OS (AIO)		-
Graphic Card (AIO)		-

Notice : SDC product approval spec guarantee a above customer system.

Contents

Revision History

Version	Date	Page	Description
P0.0	12. Mar., 2014	All	Product information

1. General Description

Overview

LTM236FL01 is a color active matrix liquid crystal display (LCD) that uses oxide 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 23.6" is 3840 x 2160 (UHD) and this model can display up to 16.7 million colors.

Features

Application - Workstation & Desktop monitors - Display terminals for AV Products - Monitors for Industrial machine
DE (Data Enable) only mode
eDP interface
RoHS, Halogen Free
Real-8Bit Color)
TCO 6.0 compliance

General Information

Items	Specification	Unit
Pixel Pitch	0.4525(H) x 0.13575(W)	mm
Active Display Area	521.28(H) x 293.22(V)	mm
Surface Treatment	AG type, Haze 25% , Hard coating (3H)	-
Display Colors	16.7M	colors
Number of Pixels	3,840 x 2,160	pixel
Pixel Arrangement	RGB vertical stripe	-
Display Mode	Normally Black	-
Luminance of White	300(Typ.) @ Center 1P	cd/㎡
Power Consumption	Total (22.93)W (Typ.). (Panel 3.53W / BLU 19.4W)	W

Mechanical Information

Item		Min.	Typ.	Max.	Unit	Note
Module size	Horizontal (H)	544.3	544.8	545.3	mm	-
	Vertical (V)	320.0	320.5	321.0	mm	
	Depth (D)	-	-	11.0	mm	-
Weight		-	-	(2,861)	g	LCD module only

Note (1) Mechanical tolerance is ± 0.5mm unless there is a special comment.
(2) The specific prominence part, please refer to 2D drawing sheet

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)

Note (1) Ta= 25 ± 2 °C

(2) Temperature and relative humidity range are shown in the figure below.
a. 90 % RH Max. (Ta ≤ 39 °C)
b. Maximum wet-bulb temperature at 39 °C or less. (Ta ≤ 39 °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

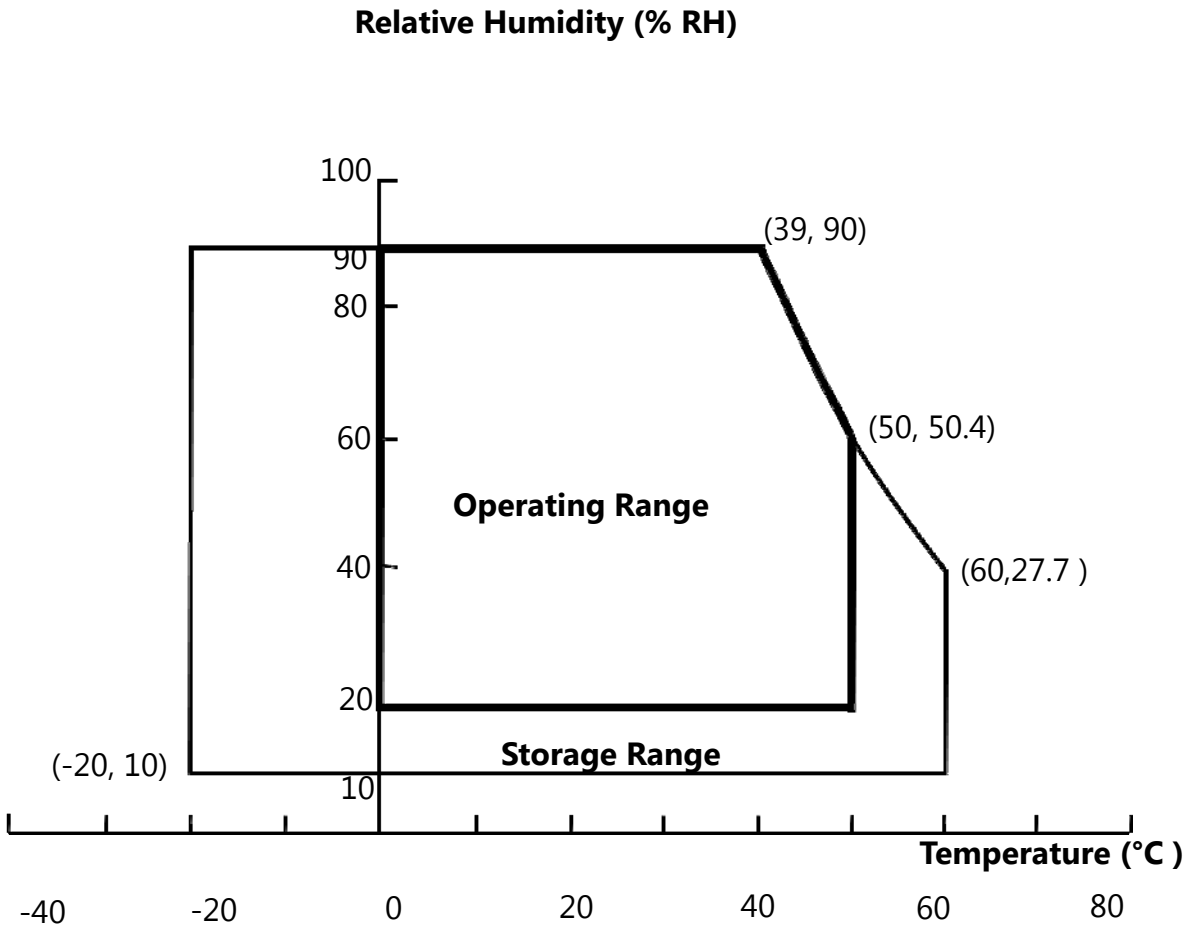


Fig. Temperature and Relative Humidity range

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}=72.46MHz, If =380mA)

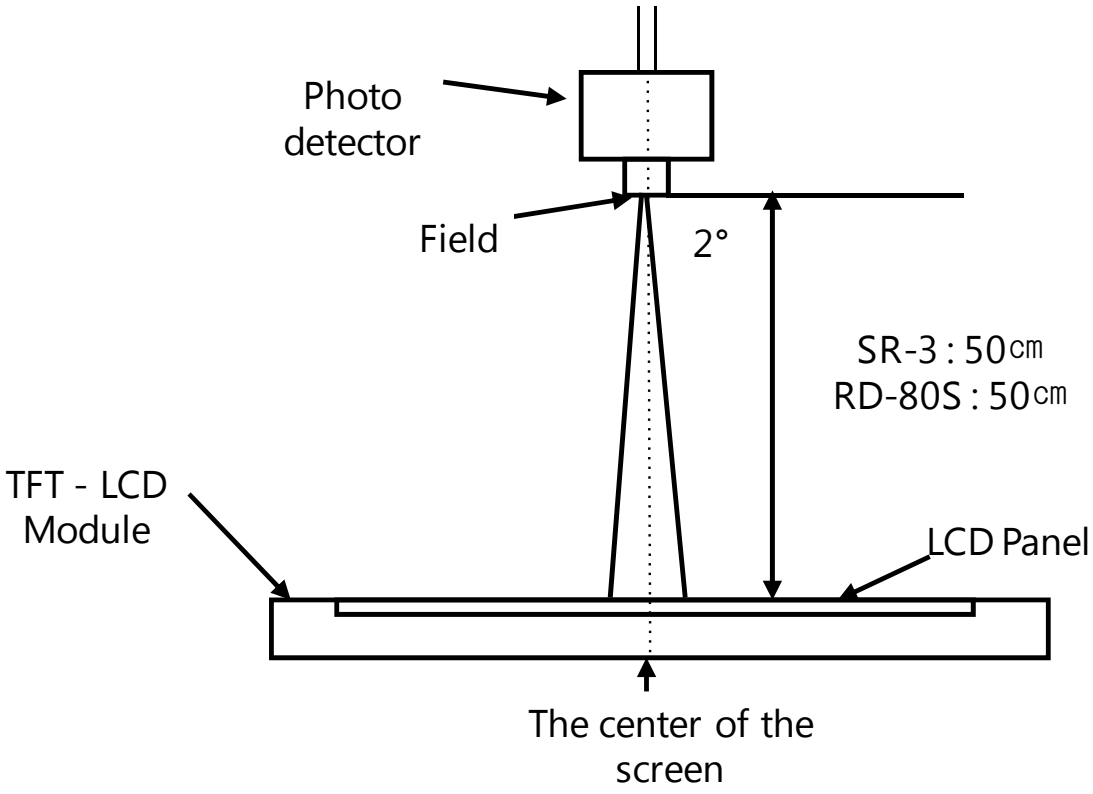
Item		Symbol	Condition	Min.	Typ.	Max.	Unit	Note
Contrast Ratio (Center of screen)		C/R		600	1000	-		(3) SR-3
Response Time		G to G		-	14	25	msec	(5) RD-80S
Luminance of White (Center of screen)		Y_L		250	300	-	cd/m^2	(6) SR-3
Brightness Uniformity (9 Points)		B_{uni}		-	-	25	%	(4) SR-3
Color Chromaticity (CIE 1931)	Red	Rx	Normal $\theta_{L,R}=0$ $\theta_{U,D}=0$ Viewing Angle	- 0.030	(0.640)	+0.030		(7),(8) SR-3
		Ry			(0.330)			
	Green	Gx			(0.290)			
		Gy			(0.600)			
	Blue	Bx			(0.150)			
		By			(0.060)			
	White	Wx			0.313			
		Wy			0.329			
Color Chromaticity (CIE 1976)	Red	Ru'		-	(0.451)	-		
		Rv'		-	(0.523)	-		
	Green	Gu'		-	(0.121)	-		
		Gv'		-	(0.561)	-		
	Blue	Bu'		-	(0.175)	-		
		Bv'		-	(0.158)	-		
	White	Wu'		-	0.198	-		
		Wv'		-	0.468	-		

Item		Symbol	Condition	Min.	Typ.	Max.	Unit	Note
Color Gamut(sRGB)		-		-	100	-	%	CIE1976
Color Temperature		-		-	6500	-	K	
Viewing Angle	Hor.	θ_L	CR≥10	80	89	-	Degrees	(8) EZ-Contrast
		θ_R		80	89	-		
	Ver.	θ_U		80	89	-		
		θ_D		80	89	-		

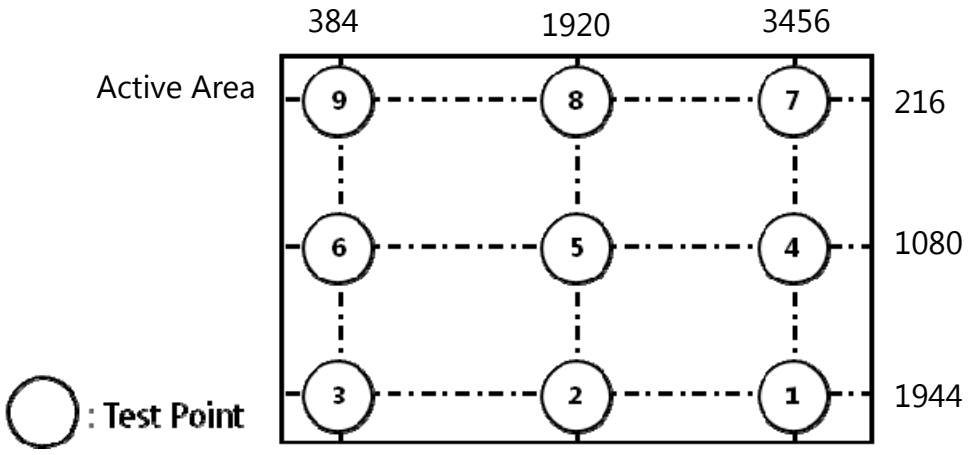
Note (1) Test Equipment Setup

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 = 380mA 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 point⑤ 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 9 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

GtoG : The time for transitions between specific gray levels

- 31 → 63, 63 → 95, 95 → 127, 127 → 159, 159 → 191 , 191 → 223 grays and vice versa
- G to G typ. : Average time at rising and falling for gray transition except the transition

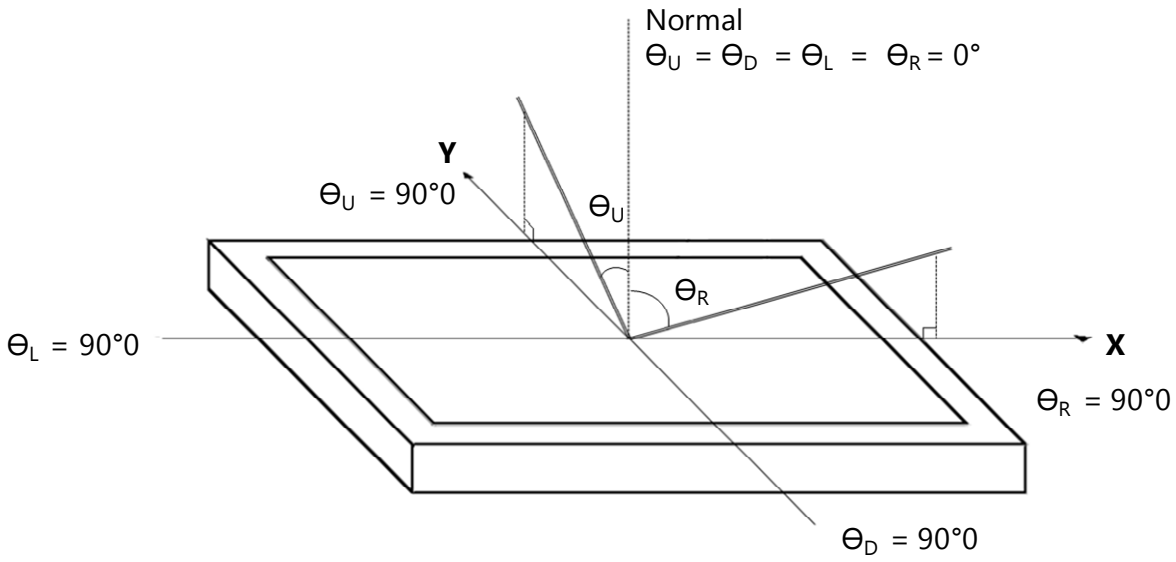
(6) Definition of Luminance of White : Luminance of white at center point (5)

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

Color coordinate of Red, Green, Blue & White at center point (5)

(8) Definition of Viewing Angle

: Viewing angle range (CR ≥ 10)



4. Block Diagram

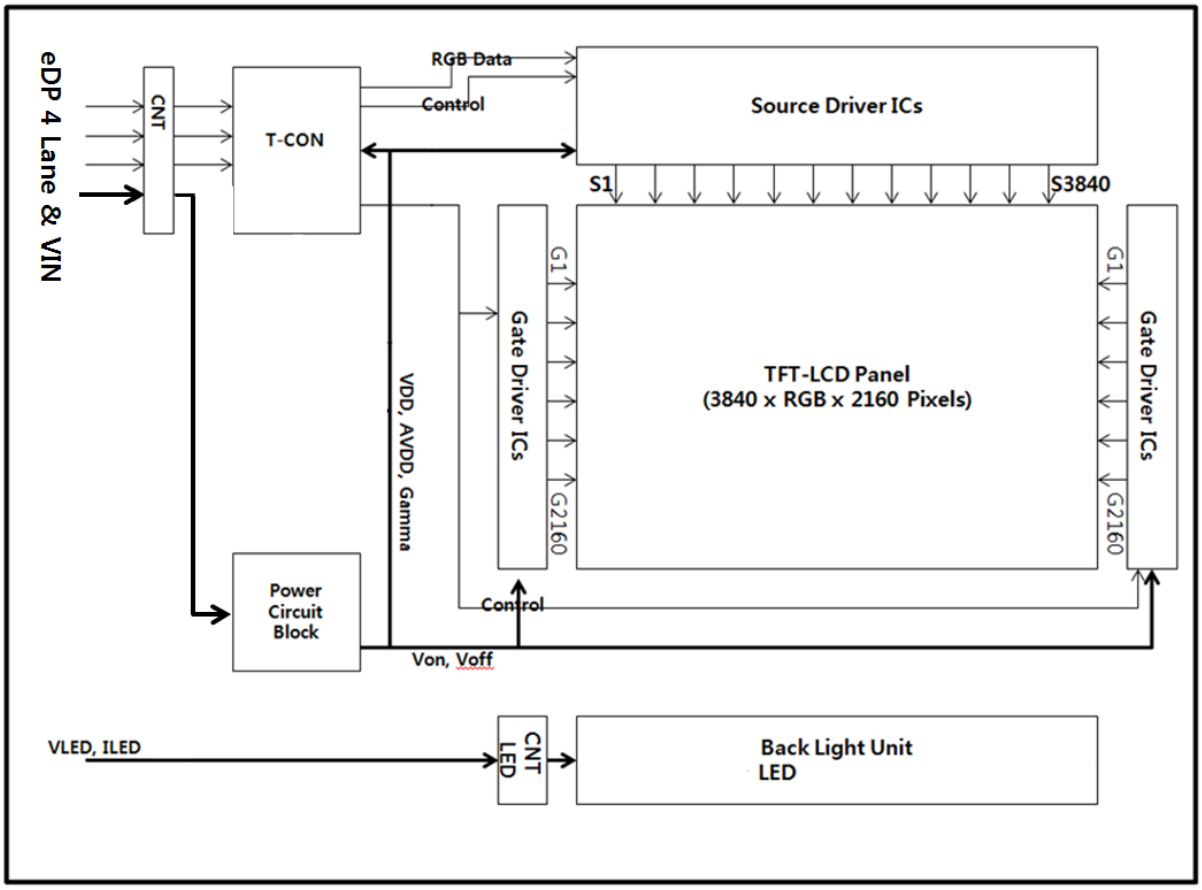


Fig. Function Block Diagram

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.

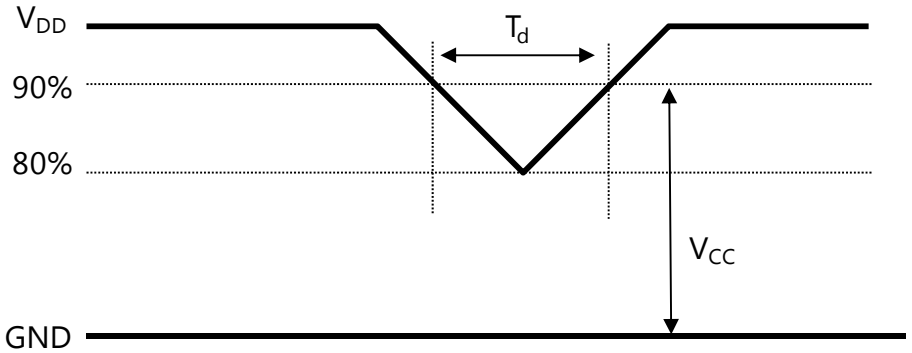
Ta=25 ± 2°C

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	I_{DD}	-	(696)	-	mA	(3),(4)
	(b) Black		-	(696)	-	mA	
	(c) Mosaic		-	(706)	-	mA	
	(d) Dot			(1460)	-	mA	
Power Consumption		P_{LCD}	-	(3.53)	-	Watt	(4),(5)
Rush Current		I_{RUSH}	-	-	3	A	(6)

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

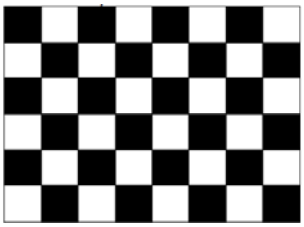
(3) f_V=60Hz, f_{DCLK} = 67.3Hz, V_{DD} = 5.0V, DC Current.

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

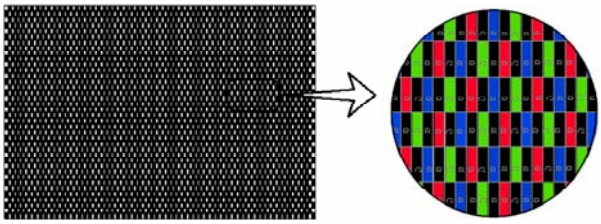
a) White Pattern

b) Black Pattern

c)Mosaic Pattern

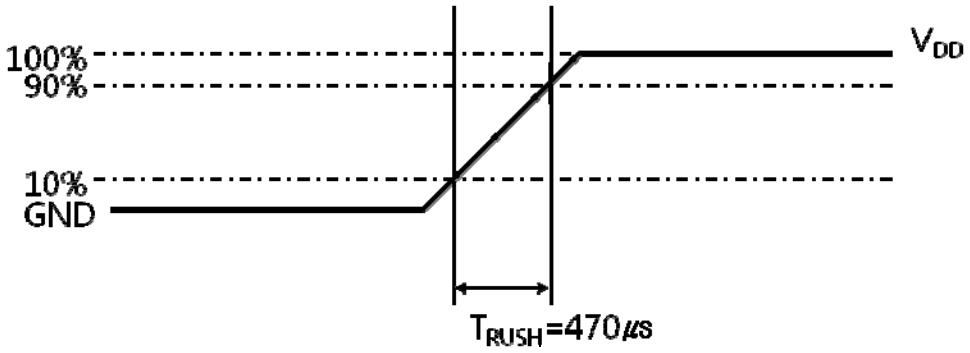


d) Dot Pattern



(5) The power consumption is specified whereas Mosaic pattern is displayed at f_V=60Hz, f_{DCLK} = 72.46MHz, V_{DD} = 5.0V

(6) Measurement Condition



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

5.2 Backlight Unit

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

Item	Symbol	Min.	Typ.	Max.	Unit	Note
LED Forward Current	I_F	-	380	(400)	mA	(1),(2)
LED Array Voltage	V_P	-	50.1	55.1	V	(1)
Power Consumption	P_{BLU}	-	19.04	-	Watt	(3)
Operating Life Time	Hr	30,000	-	-	Hour	(4)

Note (1) The above specification is not for the converter output, but for the LED bar.
- The LED bar consists of 64 LED packages : 4 parallel X 16 serial
- LED current is defined at 100% duty ratio of LED driver

(2) The LED Forward current for single LED channel is Typ. 95mA
- 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 390mA 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 =380mA.

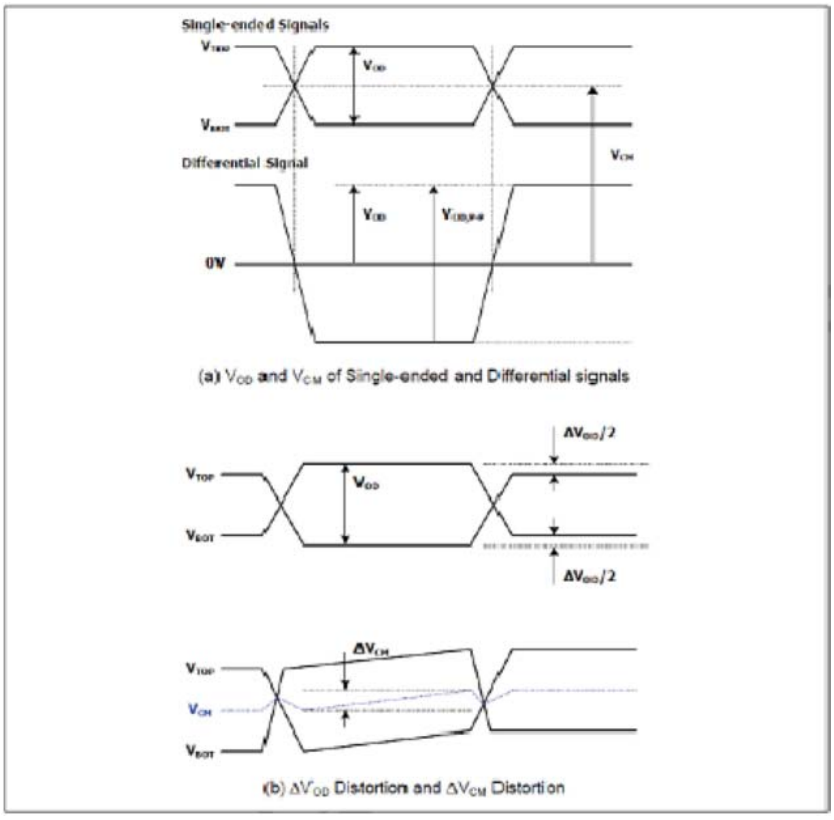
5.3 eDP Characteristics

5.3.1. eDP Input Characteristics

Ta=25 ± 2°C

Symbol	Parameter	Min	Typ	Max	Unit
V_{OD}	Output differential voltage $\|V_{TOP} - V_{BOT}\|$ 1	75	100	130	mV
		150	200	250	
		250	300	350	
		320	400	480	
		400	500	600	
		500	600	700	
V_{CM}	Output common mode voltage $(V_{TOP} + V_{BOT})/2$	0.4	0.55	0.65	V
ΔV_{OD}	Variation in V_{OD} between 0 and 1	-	-	30	mV
ΔV_{CM}	Variation in V_{CM} between 0 and 1	-	-	30	mV
R_{TX}	Transmitter differential output impedance2	70	100	130	ohm
		84	120	156	
		91	130	169	
		98	140	182	
		119	170	221	
		129.5	185	240.5	
		140	200	260	
		154	220	286	
		224	320	416	
		252	360	468	
		308	440	572	

1. $|V_{TOP}–V_{BOT}|$:To reduce power consumption and peak current, V_{OD} is programmed by an external EEPROM.
2. R_{TX} is programmed by an external EEPROM. This is for EMI reduction by controlling rising and falling time of output signals.



5.4 Interface Timing Specification

5.4.1. Timing Parameters

SIGNAL	ITEM	SYMBOL	Min.	Typ.	Max.	Unit	Note
Clock	Frequency	$1/T_C$	TBD	(519.8)	TBD	MHz	-
Hsync		F_H	TBD	(131.4)	TBD	kHz	-
Vsync		F_V		60		Hz	-
Vertical Display Term	Active Display Period	T_{VD}		2160		Lines	-
	Vertical Total	T_V	TBD	(2190)	TBD	Lines	-
Horizontal Display Term	Active Display Period	T_{HD}		3849		Clocks	-
	Horizontal Total	T_H	TBD	(3956)		clocks	8pixel/clock

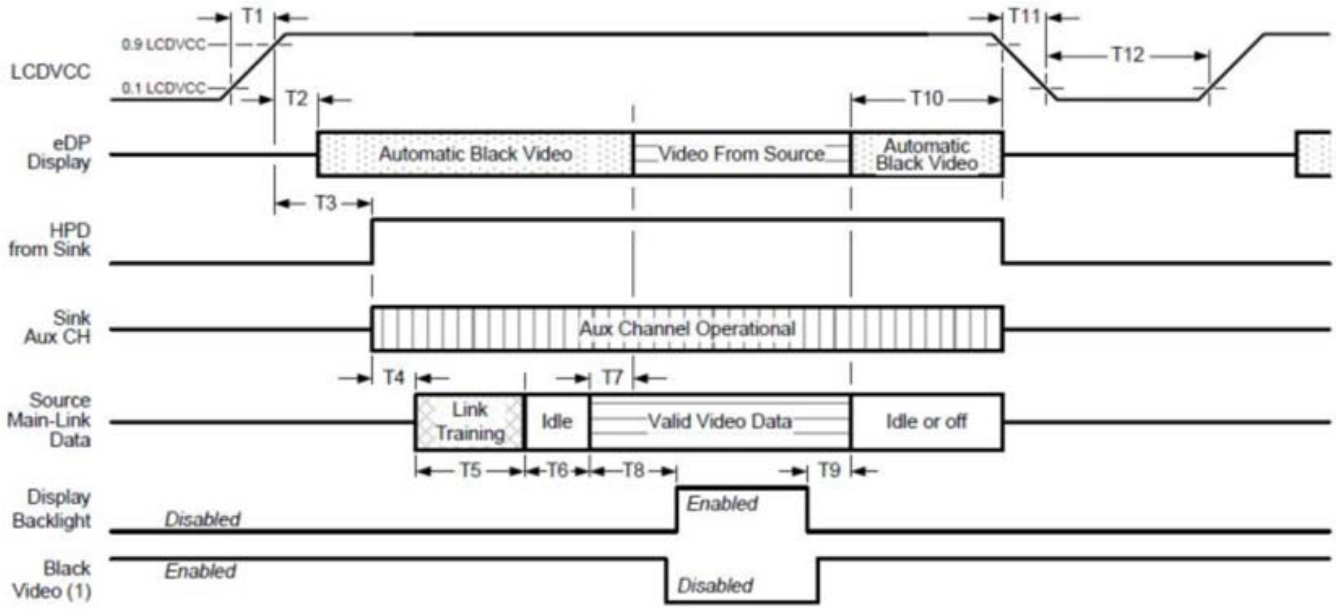
Note (1) Best operation clock frequency is (519.8)MHz(60Hz)

(2) Max, Min variation range is at main clock typical value (519.8)MHz

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

5.5 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.



Timing (ms)	Remarks
$0.5 < T_1 \leq 10$	LCDVCC Power Rising time 10~90%
$0 < T_2 \leq 200$	Delay from LCDVCC to automatic Black Video generation
$0 < T_3 \leq 100$	Delay from LCDVCC to HPD high
$0 \leq T_4$	Delay from HPD high to link training initialization
$0 \leq T_5$	Link training duration
$0 \leq T_6$	Link idle
$0 < T_7 \leq 50$	Delay from valid video data from Source to video on display
$50 < T_8$	Delay from valid video data from Source to backlight enable
$50 < T_9$	Delay from backlight disable to end of valid video data
$0 < T_{10} \leq 500$	Delay from end of valid video data from source to power off
$0 < T_{11} \leq 20$	LCDVCC Power Falling time 90~10%
$500 < T_{12}$	Power Off time

The backlight may be flashed if the interface signal remains floated when the above-mentioned signal becomes invalid.

Note (1) The Sink must include the ability to automatically generate Black Video autonomously.
The Sink must automatically enable Black Video under the following conditions:
Upon LCDVCC power-on (within T2 max)
When the “NoVideoStream_Flag”(VB-ID Bit 3) is received from the Source

(at the end of T9)
When no Main Link data, or invalid video data, is received from the Source. Black Video Must be displayed within 50ms (max) from the start of either condition. Video data can Deemed invalid based on MSA and timing information for example.

(2) The Sink may implement the ability to disable the automatic Black Video function, as described in Note 1, above, for system development and debugging purposes.

(3) The Sink must support AUX Channel polling by the Source immediately following LCDVCC power-on without causing damage to the Sink device (the Source can re-try if the Sink is not ready). The Sink must be able to respond to an AUX Channel transaction with the time specified within T3 max.

5.7 Input Terminal Pin Assignment

5.7.1. Input signal & Power Pin Assignment

Connector : IPEX 20455-030E-02R or equivalent

Pin No.	Symbol	Function
1	HPD	Hot Plug Detection
2	GND	Ground
3	DRX3N	main link
4	DRX3P	main link
5	GND	Ground
6	DRX2N	main link
7	DRX2P	main link
8	GND	Ground
9	DRX1N	main link
10	DRX1P	main link
11	GND	Ground
12	DRX0N	Aux Channel
13	DRX0P	Aux Channel
14	GND	Ground
15	DAUXP	Aux Channel
16	DAUXN	Aux Channel
17	GND	Ground
18	NC	No connection (SDC Internal Only)
19	BIST_EN	BIST Control
20	GND	Ground
21	GND	Ground
22	GND	Ground
23	GND	Ground
24	GND	Ground
25	NC	No connection
26	PVDD	Power
27	PVDD	Power
28	PVDD	Power
29	PVDD	Power
30	PVDD	Power

Note (1) All GND pins should be connected together and also be connected to the LCD's metal chassis.

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

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

5.7.2. LED Connector Pin assignment

Connector : Molex 104193-0610 pr equivalent
- The mating type connector : Molex 104092-0600 or equivalent

Pin No.	Symbol	Function
1	RNT 1	Channel 1 LED Return
2	RTN 2	Channel 2 LED return
3	VLED	LED Power Input
4	VLED	LED Power Input
5	RTN 3	Channel 3 LED Return
6	RTN 4	Channel 4 LED Return

Note (1) Pin number starts from Right side

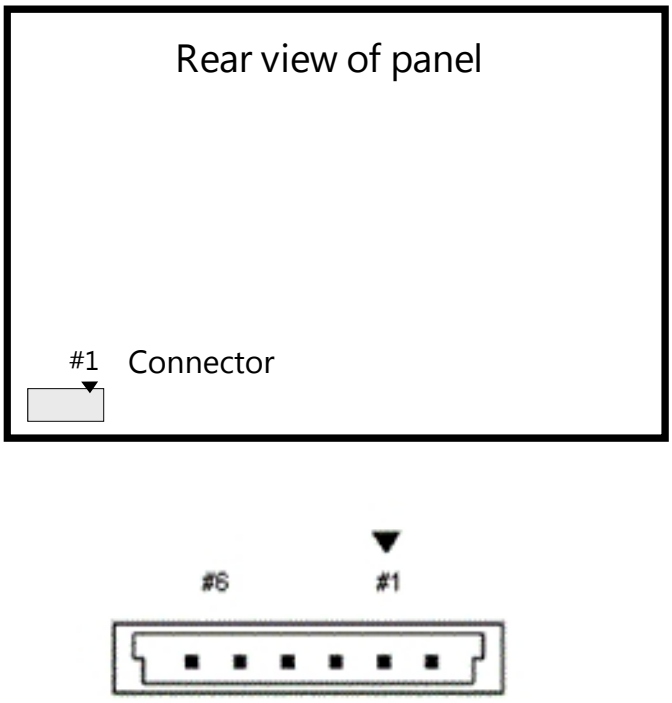


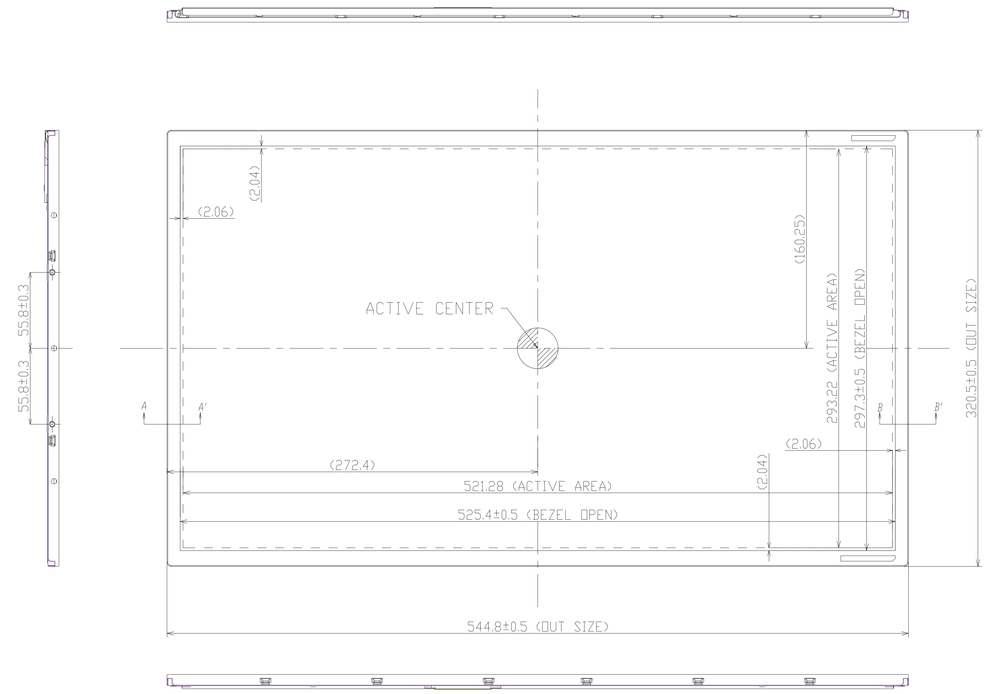
Fig. Connector diagram

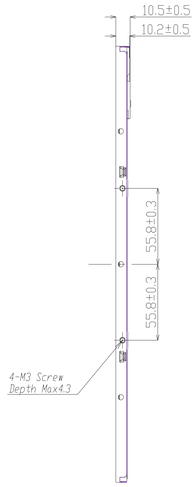
6. Outline Dimension

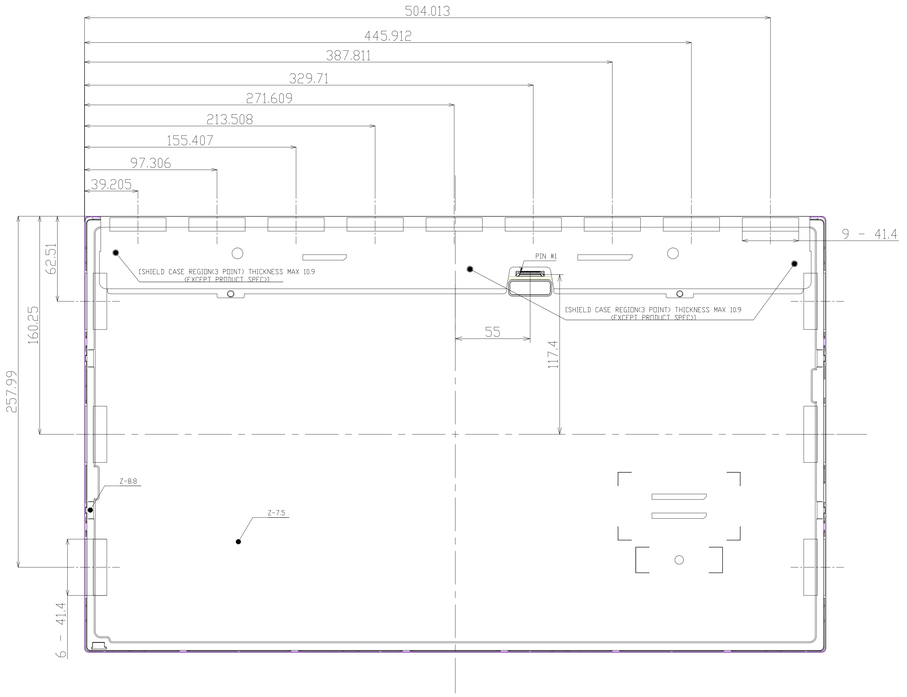
[Refer to the next page]

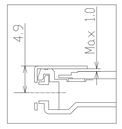
FILE NO.

NO	PART NAME	CODE NO	SPECIFICATION	Q'TY	WEIGHT (NOM)	WEIGHT (MODUL)	APPLIED IN (F. MODUL)	REMARK

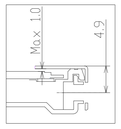








Section A-A'



Section B-B'

PRELIMINARY

* NOTES

1. BACKLIGHT : 23.6" PLS SLIM WHITE LED

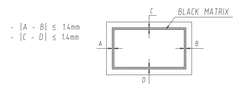
2. LED CONNECTOR SPECIFICATION.
   - MAKER : MOLEX
   - PART NO. : 1041930610
     OR equivalent

3. I/F CONNECTOR SPECIFICATION.
   - MAKER : -
   - PART NO. : 3710-002849

4. USER MOUNTING TORQUE SPEC : 3 ~ 4 kgf-cm

5. Screw Length
   - Min 1.5(Available threads : 3ea)
   - Max 2.0(Available threads : 4ea)

6. BLACK MATRIX SPEC



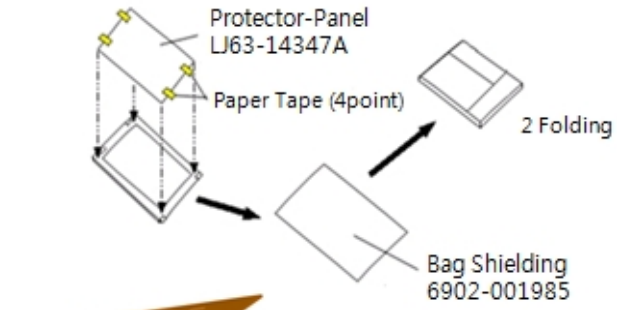
REVISION

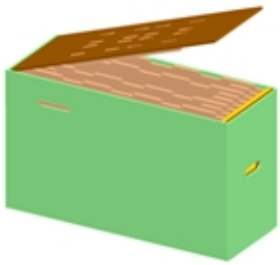
GENERAL TOLERANCE				REV BY	DATE	DESCRIPTION OF REVISION			REASON			
STEP	LEVEL 1	LEVEL 2	LEVEL 3	UNIT	mm	DRAWN BY	DES'D BY	CHK'D BY	APP'D BY	MODEL NAME	23.6" UHD		
0 < X < 4	±0.20	±0.1	±0.2	SCALE	/	K.H. LEE							
4 < X < 16	±0.08	±0.15	±0.3	TOLERANCE	±0.0					PART/SHEET NAME	OUT LINE-DIM	SHEET	/
16 < X < 64	±0.12	±0.25	±0.5										
64 < X < 256	±0.25	±0.4	±0.8	SAMSUNG DISPLAY					SPEC. NO.	CODE NO.		VER.	

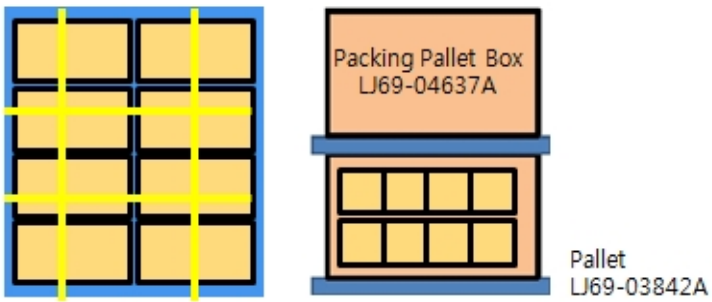
7.Packing

7.1 Carton

Item	Packing form	Specification
Packing case	10 panels in a case	- Packing Case Size : W282 x L614 x H366 - Material : Paper (SW,DW)
Pallet box	16 cases in a box 160 panels in a box	- Packing Pallet Box Size : W1140 x L1256 x H702 - Material : Paper (SW)
Pallet	-	- Pallet Size : W1270 x L1150 x H122 - Material : Wood



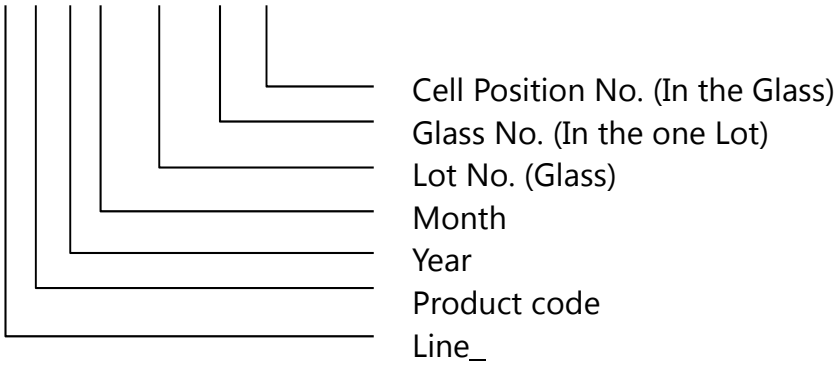




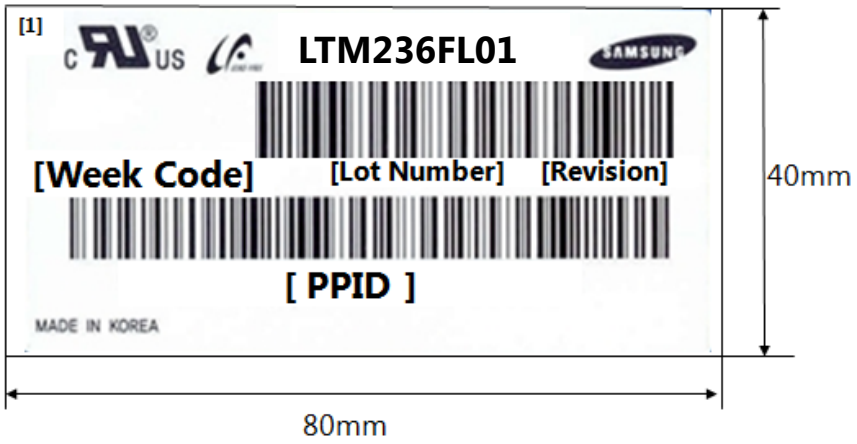
7.2 Marking

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

(1) Parts number : LTM236FL01
(2) Revision: Three letters
(3) Lot number : X X X X XXX XX X



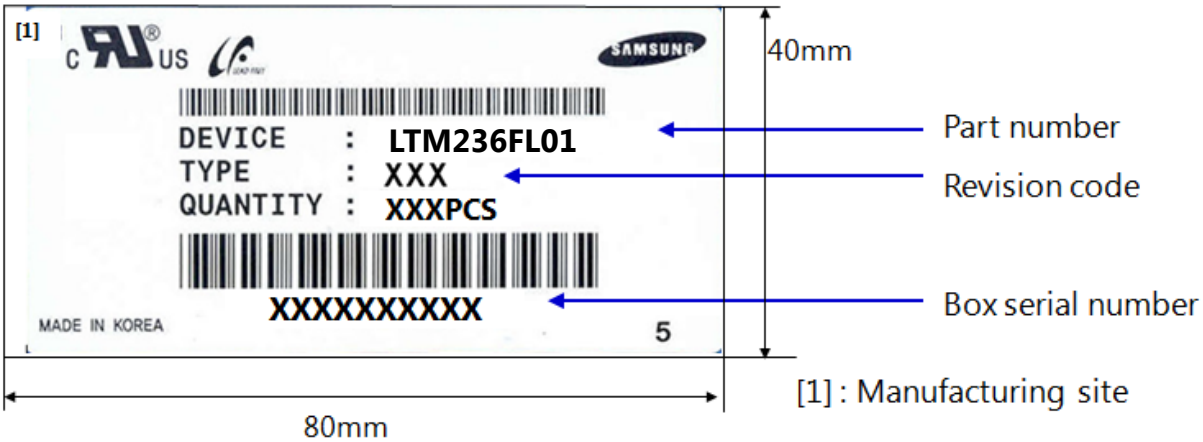
(4) Nameplate Indication



Week code : 11 09
week
year

[1] : Manufacturing site

(5) Packing box attach



[1] : Manufacturing site

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.

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.

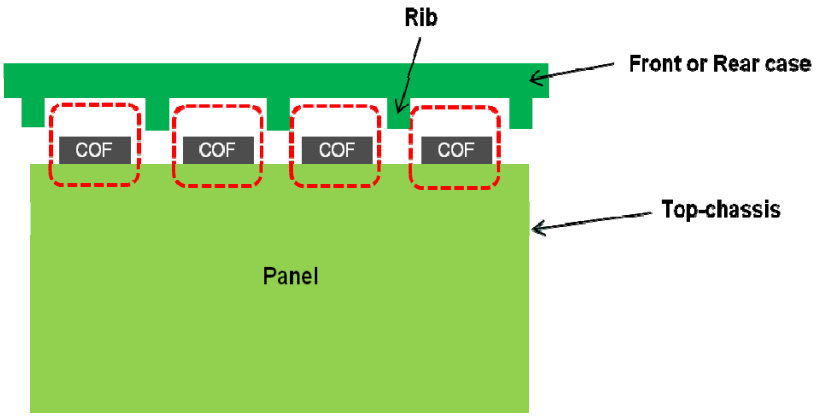
K. Please contact SAMSUNG beforehand, if you plan to display the same pattern for a long period of time.

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. The LED driver should be designed in compliance with the specifications of LED bar strictly to make the LED in LCD module perform as expected

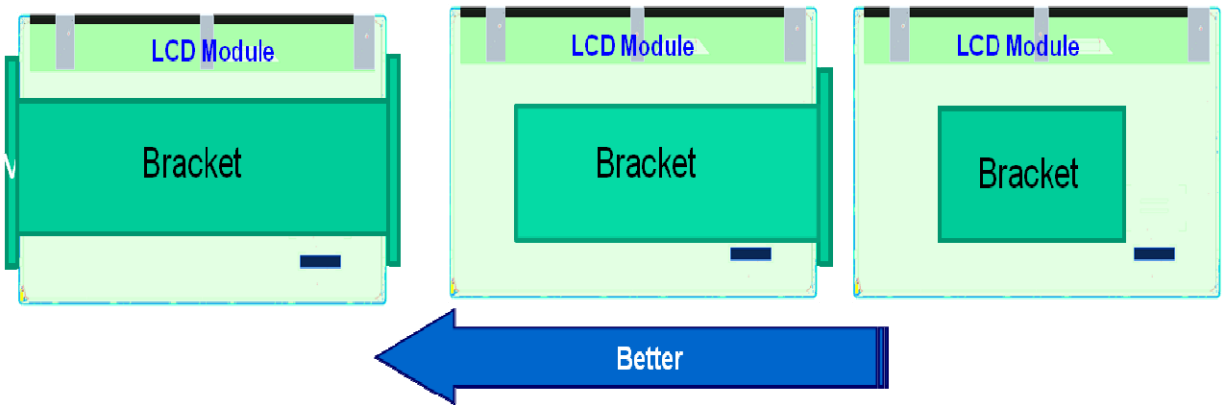
B. It is recommended that you locate the rib on the front or rear cover not to be placed on the spot where D-IC is located on the upper or left of LCD module.



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

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

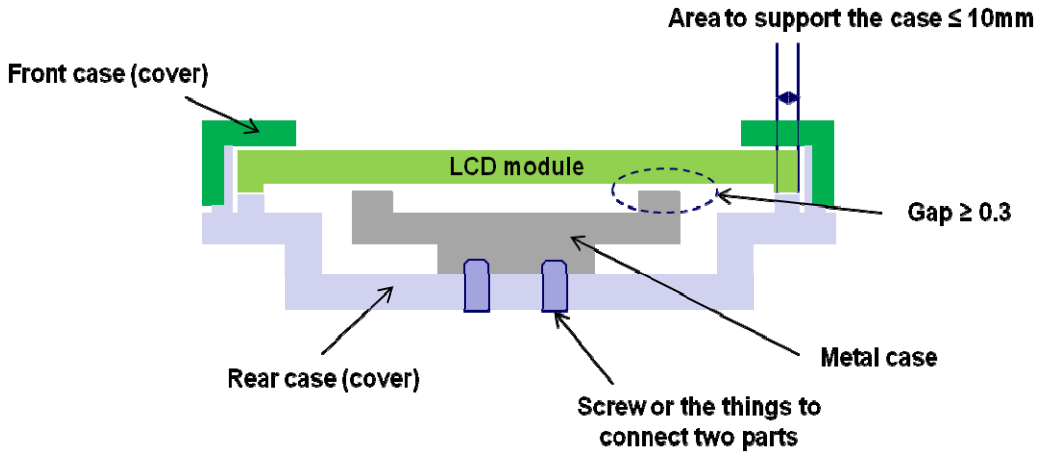
E. It is recommended that you design the bracket not to be interfered with the SET at the area where the PBA of module is located.



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

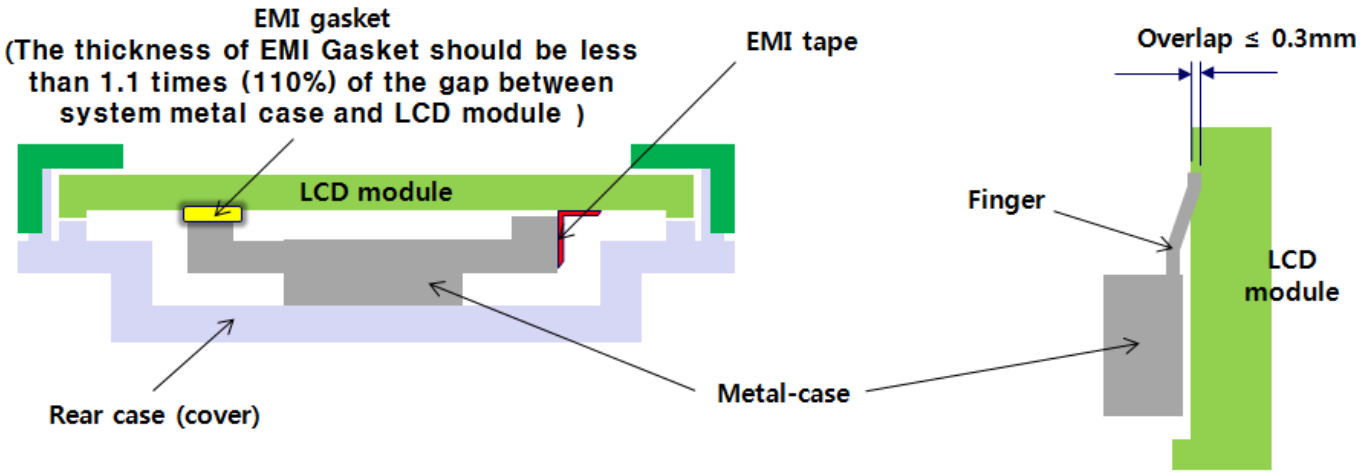
G. It is recommended that structure to support the module shall be far away 10mm from the edge of border.

H. 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.



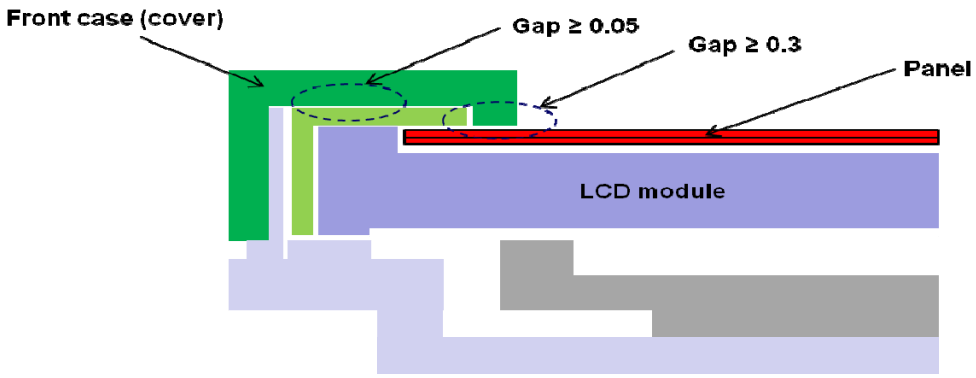
I. When applying the measures described below to reduce the level of EMI which occurs between the metal cover and the rear of module.

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

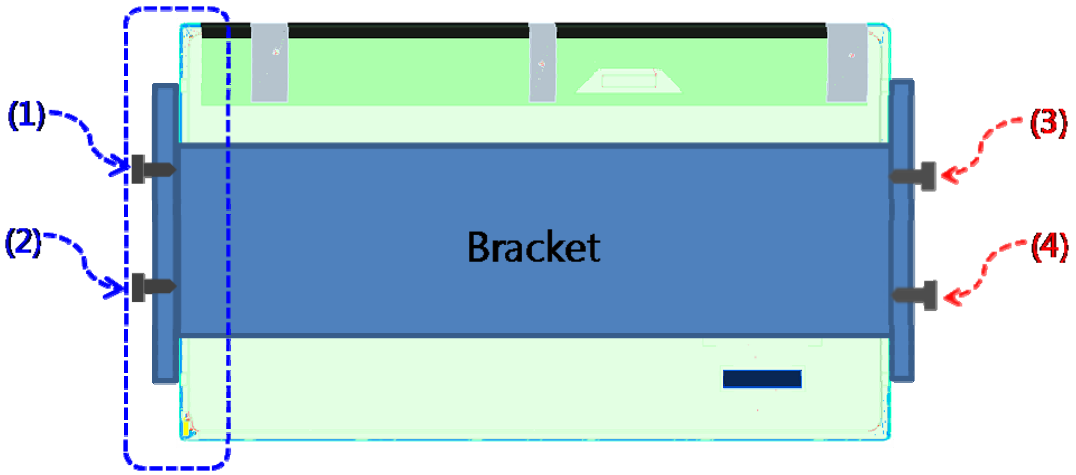


K. It is recommended that more than 0.3mm gap between the front case (or cover) and the panel glass is allowable.

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



M. 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.



N. 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.