SPECIFICATION
FOR
APPROVAL

(●) Preliminary Specification
( ) Final Specification

Title	12.3”FHD (1920 X RGB X 720) TFT- LCD

BUYER	Faurecia
MODEL	

SUPPLIER	LG Display Co., Ltd.
MODEL	LA123WF7
SUFFIX	SL09

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Record of Revisions

Revision No.	Revision Date	Page	Description	Note
0.0	Dec.23.2020	-	First Draft (Preliminary)	

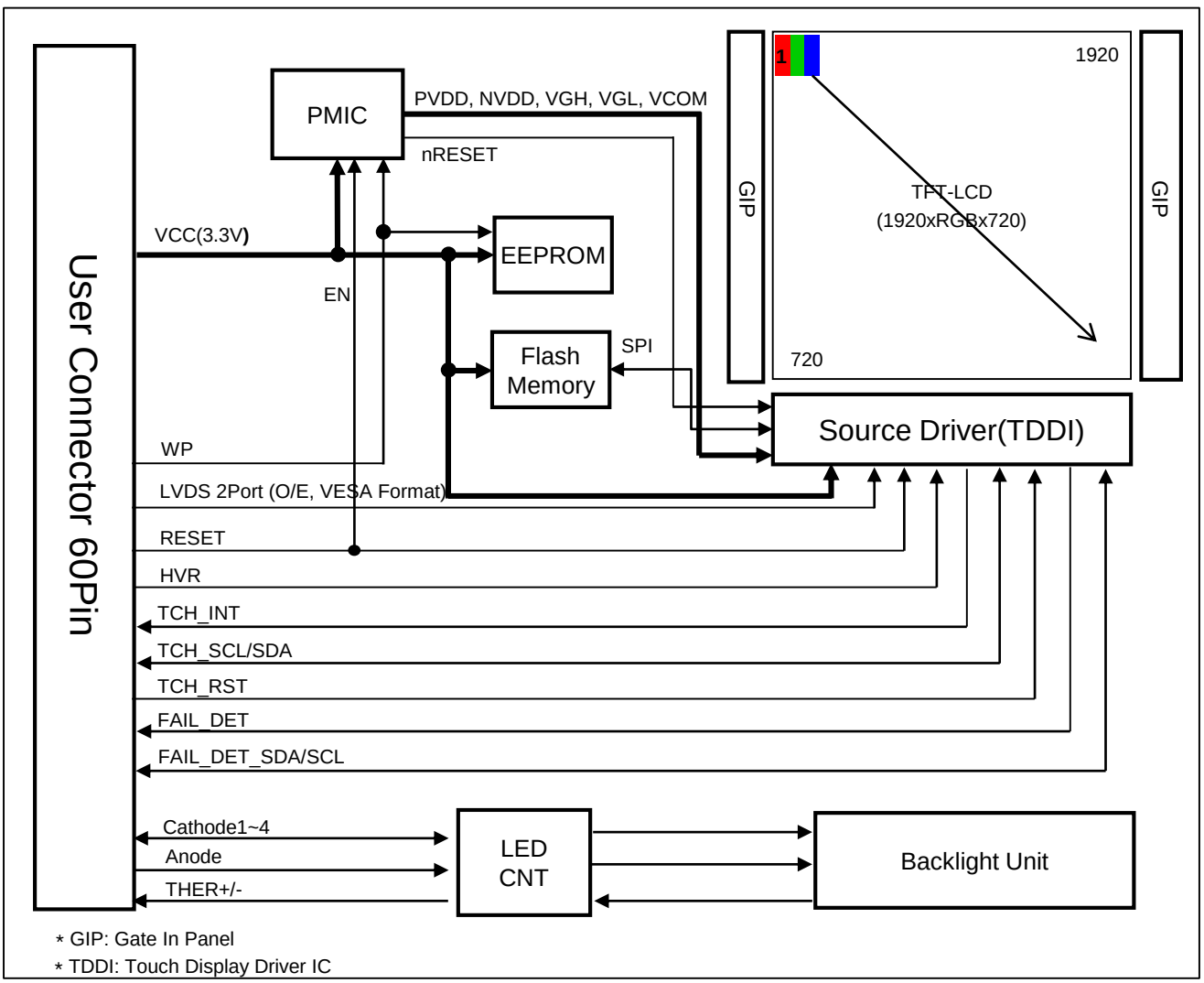
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1. Summary

This LCD panel utilizes thin film transistors and a 8:3 aspect ratio. The 12.3” active matrix liquid crystal display allows 16,777,216 colors to be displayed by LVDS interface.

2. Features

- This LCD panel has a 8:3 aspect ratio.
- The 12.3” screen produces a high resolution image that is composed of 1,382,400 pixel elements in a stripe arrangement.
- In Plane Switching (IPS) technology, provide a wide viewing angle.
- By adopting an active matrix drive, a picture with high contrast is realized.
- By using COG mounting technology, the module became thin, light and compact.
- By adopting a high aperture panel, high transmittance color filter and high transmission polarizing plates, transmittance ratio is realized.
- Gray scale or the brightness of the sub-pixel color is determined with a 8-bit gray scale signal.



* GIP: Gate In Panel
* TDDI: Touch Display Driver IC

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3. General Description

Active Screen Size		12.3 inches diagonal
Outline Dimension		299.53mm(H,Typ.) x 123.26mm(V,Typ.) x 6.05mm(D,Typ.)
Pixel Pitch		0.1521mm x 0.1521mm
Pixel Format		1920 horiz. by 720 vert. Pixels, RGB stripe arrangement
Color Depth		8bit, 16,777,216colors
Luminance, White		1000 cd/m^2 (@Center 1point, Typ.)
Viewing Angle(CR>10)		89/89/89/89(L/R/U/D, Typ.)
Power Consumption		Total: 10.62W(Typ.), Logic: 1.02W(Typ.), B/L: 9.6 W(Typ.) [I_{BL}= 100㎃]
Weight		274 g(Typ.), 284 g(Max.)
Display Mode		Transmissive mode, Normally Black
Surface Treatment	Material	Hard coating
	Hardness	3H (ISO15184, @Load 500g)
	Reflectance	Max 5.5%(SCI)
Backlight Type		LED
RoHS Compliance		Yes

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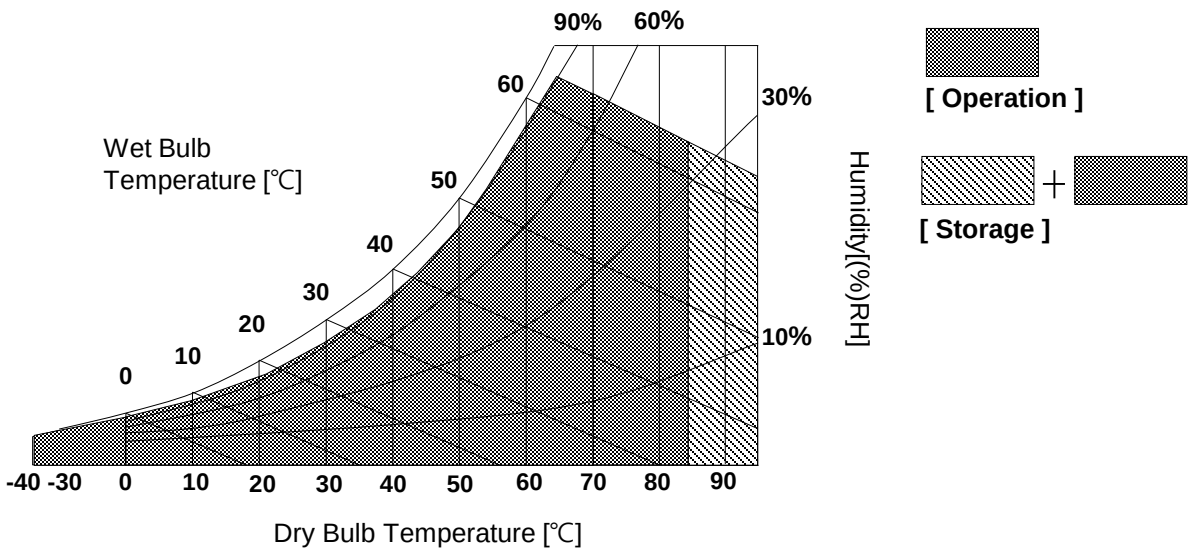
4. Absolute Maximum Ratings

The following items are maximum values which, if exceeded, may cause faulty operation or damage to the LCD panel.

Table 4-1. ABSOLUTE MAXIMUM RATINGS

Parameter		Symbol	Value		Unit	Note
			Min.	Max.		
Power Supply Voltage	LCD	V_{CC}	-0.3	3.9	V	1
	Backlight	V_{ANODE}	-0.3	38.0		
Input Signal Voltage		V_{LVDS}	-0.3	2.5	V	2
		V_{CTRL}	-0.3	3.6	V	
Storage Temperature		T_{ST}	-40	95	℃	3
Operating Temperature		T_{OP}	-40	85	℃	3,4,5

Note 1. The system should supply enough current for TFT LCD's stable operation at -40 ~ +85℃.
2. V_{LVDS}: LVDS input signal(RAxN/P_O/E, RBxN/P_O/E, RCxN/P_O/E, RCLKxN/P_O/E, RDxN/P_O/E)
V_{CTRL}: TCH_INT/SCL/SDA/RST, WP, HVR, RESET.
3. Temperature and relative humidity range are shown in the figure below.
Wet bulb temperature should be Max. 62℃. Condensation of dew must be avoided, because it may cause electrical current leakage, and deterioration of performance and quality.
4. The operating temperature is the temperature under which the LCD panel circuits operate normally. All the contents of chapter 7 Electro-optical specifications are provided on the condition of the room temperature.
5. This temperatures here in are reference values for the ambient temperature with the heat which is generated by operation of circuit and backlight



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5. Electrical Specifications

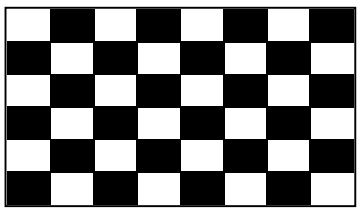
5-1. Electrical Characteristics

Table 5-1-1. LCD DRIVING CIRCUIT ELECTRICAL CHARACTERISTICS

Parameter		Symbol	Value			Unit	Note
			Min.	Typ.	Max.		
Power Supply Voltage		V_{CC}	3.0	3.3	3.6	V	
Power Supply Current	Mosaic	I_{VCC}	-	300	390	mA	1
	White			310	400		
Power Consumption		P_{VCC}	-	1.02	1.32	W	1, 2
Rush Current		I_{RUSH}	-	-	2.0	A	3
Permissive input ripple					200	mVpp	
Input/Output Signal Voltage		V_H	0.8*V_{CC}	-	V_{CC}	V	4,5
		V_L	0	-	0.2*V_{CC}	V	

Note 1. The specified current and power consumption are under the V_{CC} = 3.3V, Ta=25 ± 2°C, fv=60Hz condition where Mosaic Pattern(8x6) and white Pattern are displayed.

White: 255Gray, Black: 0Gray



Mosaic Pattern(8 X 6)

White : 255 Gray



White Pattern

2. P_{VCC}(Typ.) = I_{VCC}(Typ.)*V_{CC}(Typ.), P_{VCC}(Max) = I_{VCC}(Max)*V_{CC}(Typ.) where Mosaic Pattern.
3. The duration of rush current is about 2ms and rising time of power input is 0.5ms(min). (V_{CC} = 3.3V, Ta=25 ± 2°C, fv=60Hz)
4. TCH_INT, TCH_SCL, TCH_SDA, TCH_RST, WP, HVR, RESET. HVR pins should be pulled-down to low internally.
5. The values indicate the ranges in which the device can operate normally. Operation beyond the limit of the range is not assured, even though other operating conditions are within the limit of the maximum ratings.

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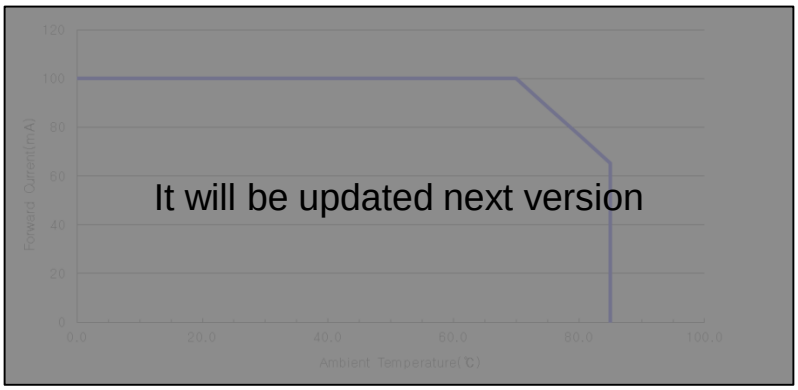
Table 5-1-2. BACKLIGHT ELECTRICAL CHARACTERISTICS

Parameter		Symbol	Values			Unit	Note
			Min.	Typ.	Max.		
LED Current		I_{LED}	-	100	105	mA	1,2,6
LED Voltage	-30℃	V_{LED}	22.4	24.8	28.0	V	1String
	+25℃		20.8	23.2	26.4		1String
	+85℃		20.0	22.4	25.6		1String
LED Power		P_{LED}		9.28	11.76	W	3
LED Chain			-	4	-	EA	4
LED Life Time			10,000	-	-	Hrs	5

Note 1. Values apply to one chain (8-LED connected in each chain)

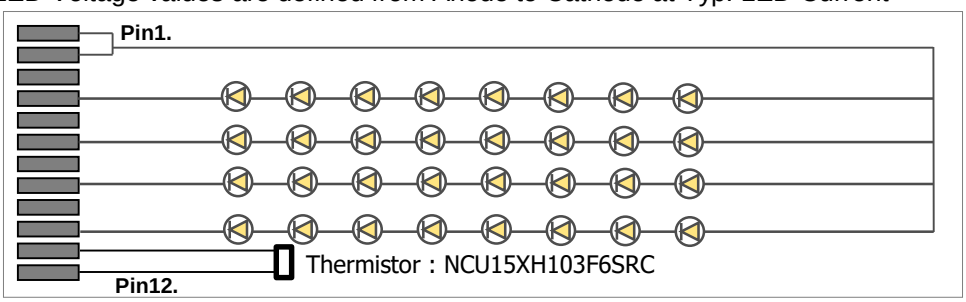
2. The permissible forward current of LED varies with environmental temperature.

■ Ambient Temperature vs. Allowable Forward Current



3. LED Power
   - Typ. LED Power = Typ. LED Current x +25℃ Typ. LED Voltage x LED Chain number
   - Max. LED Power = Max. LED Current x -30℃ Max. LED Voltage x LED Chain number

4. LED Chain
   - The LED Voltage values are defined from Anode to Cathode at Typ. LED Current



5. The life time is determined as the time during which brightness of LCM is no less than 80% compare to that of initial value at the typical LED current.

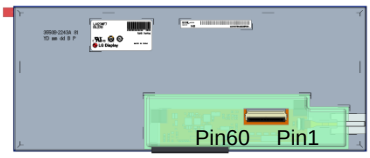
6. DC current dimming is recommended for LED control. If PWM dimming is needed, PWM frequency should be optimized for minimal wavy and audible noise.

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5-2. Interface Connections

5-2-1. User Connector Pin Configuration

The electronics interface connector is a model 04-6499-860 manufactured by KYOCERA or equivalent.



[Connector]
KYOCERA 04-6499-860-921-846, 60Pin

Table 5-2-1. USER CONNECTOR PIN CONFIGURATION

Pin No	Name	I/O	Description	Note
1	GND	-	Ground	1
2	NC	-	No Connection	3
3	Anode	I	Anode	
4	Anode	I	Anode	
5	NC	I	No Connection	3
6	Cathode1	I/O	Cathode	
7	Cathode2	I/O	Cathode	
8	Cathode3	I/O	Cathode	
9	Cathode4	I/O	Cathode	
10	THER+	I/O	Thermistor (+)	
11	THER-	I/O	Thermistor (-)	
12	NC	-	No Connection	3
13	V_{CC}	I	LCD Power Supply Voltage (+3.3V, Typical)	4
14	V_{CC}	I	LCD Power Supply Voltage (+3.3V, Typical)	4
15	V_{CC}	I	LCD Power Supply Voltage (+3.3V, Typical)	4
16	NC	-	No Connection	3
17	TCH_INT	O	Interrupt Signal for Touch	
18	TCH_SCL	I	I2C Clock for Touch	
19	TCH_SDA	I	I2C Data for Touch	
20	TCH_RST	I	Reset Signal for Touch	
21	GND	-	Ground	1
22	WP	I	I2C Write Protection (H: Protection, L:Write)	5
23	FAIL_DET	O	Failure Detect Pin	6
24	HVR	I	Horizontal and Vertical Reverse	2
25	RESET	I	Reset Signal for LCD	
26	NC	-	No Connection (LGD Internal Test Pin)	3
27	NC	-	No Connection (LGD Internal Test Pin)	3
28	FAIL_DET_SDA	I/O	I2C SDA for monitoring failure detect	8
29	FAIL_DET_SCL	I/O	I2C SCL for monitoring failure detect	8
30	GND	-	Ground	1
31	RAM_E	I	Negative LVDS differential data Input for even pixel(A-)	
32	RAP_E	I	Positive LVDS differential data Input for even pixel(A+)	
33	GND	-	Ground	1
34	RBM_E	I	Negative LVDS differential data Input for even pixel(B-)	
35	RBP_E	I	Positive LVDS differential data Input for even pixel(B+)	
36	GND	-	Ground	1
37	RCM_E	I	Negative LVDS differential data Input for even pixel(C-)	
38	RCP_E	I	Positive LVDS differential data Input for even pixel(C+)	
39	GND	-	Ground	1
40	RCLKM_E	I	Negative LVDS differential clock input for even pixel(-)	

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Table 5-2-1. USER CONNECTOR PIN CONFIGURATION

Pin No	Name	I/O	Description	Note
41	RCLKP_E	I	Positive LVDS differential clock input for even pixel(+)	
42	GND	-	Ground	1
43	RDM_E	I	Negative LVDS differential data Input for even pixel(D-)	
44	RDP_E	I	Positive LVDS differential data Input for even pixel(D+)	
45	GND	-	Ground	1
46	RAM_O	I	Negative LVDS differential data Input for odd pixel(A-)	
47	RAP_O	I	Positive LVDS differential data Input for odd pixel(A+)	
48	GND	-	Ground	1
49	RBM_O	I	Negative LVDS differential data Input for odd pixel(B-)	
50	RBP_O	I	Positive LVDS differential data Input for odd pixel(B+)	
51	GND	-	Ground	1
52	RCM_O	I	Negative LVDS differential data Input for odd pixel(C-)	
53	RCP_O	I	Positive LVDS differential data Input for odd pixel(C+)	
54	GND	-	Ground	1
55	RCLKM_O	I	Negative LVDS differential clock input for odd pixel(-)	
56	RCLKP_O	I	Positive LVDS differential clock input for odd pixel(+)	
57	GND	-	Ground	1
58	RDM_O	I	Negative LVDS differential data Input for odd pixel(D-)	
59	RDP_O	I	Positive LVDS differential data Input for odd pixel(D+)	
60	GND	-	Ground	1

Note 1. All GND pins should be connected together.
2. Display Direction as following pictures.
3. Make sure that NC pins should be floated. Do not connect the pins.
4. All V_{CC} pins should be connected together.
5. WP pin is used for Write Protection. Internally WP should be pulled-up.
6. FAIL_DET means LCD module status. Please refer below table.

HVR	Display Image
Low (Regular Display)	
Hi (Horizontal and Vertical Inverted Display)	

Status	FAIL_DET
Normal	Low
Failure	High

7. Please see the Appendix-I for more information about Equivalent Circuits.
8. These pins provide LCD module operating status.(slave address 0x30)

I2C Address	D7	D6	D5	D4	D3	D2	D1	D0	Default (Normal Operating)
B2h	0	0	A	B	C	D	E	0	00000000

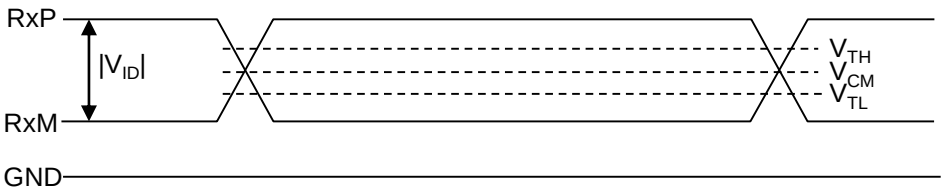
A : OTP Checksum OK/NG
B : LVDS Unlock OK/NG
C : DE Signal in LVDS OK/NG
D : I2C Communication OK/NG
E : EEPROM checksum OK/NG

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5-3. LVDS Signal Specifications

5-3-1. DC Characteristics

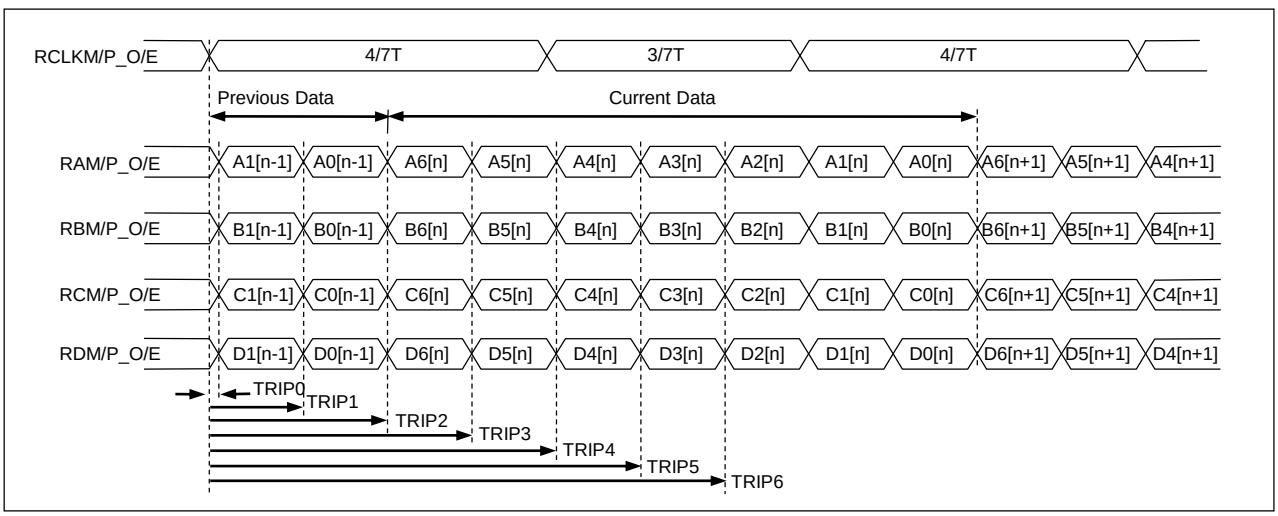
Parameter	Symbol	Min	Typ	Max	Unit	Notes
LVDS Differential Voltage	$\|V_{ID}\|$	200	350	500	mV	1
LVDS Input Common Mode Voltage	V_{CM}	1.0	1.2	1.4	V	
Positive-going Input Threshold Voltage	V_{TH}	-	-	100	mV	
Negative-going Input Threshold Voltage	V_{TL}	-100	-	-	mV	



Note 1. All LVDS Rx termination resistor(100Ω±20Ω) is integrated on the chip.(TDDI)

5-3-2. AC Characteristics (1/2)

Parameter	Symbol	Min	Typ	Max	Unit
Input Data Position for Bit0	T_{RIP0}	-	0	-	ns
Input Data Position for Bit1	T_{RIP1}	-	T/7	-	ns
Input Data Position for Bit2	T_{RIP2}	-	2T/7	-	ns
Input Data Position for Bit3	T_{RIP3}	-	3T/7	-	ns
Input Data Position for Bit4	T_{RIP4}	-	4T/7	-	ns
Input Data Position for Bit5	T_{RIP5}	-	5T/7	-	ns
Input Data Position for Bit6	T_{RIP6}	-	6T/7	-	ns

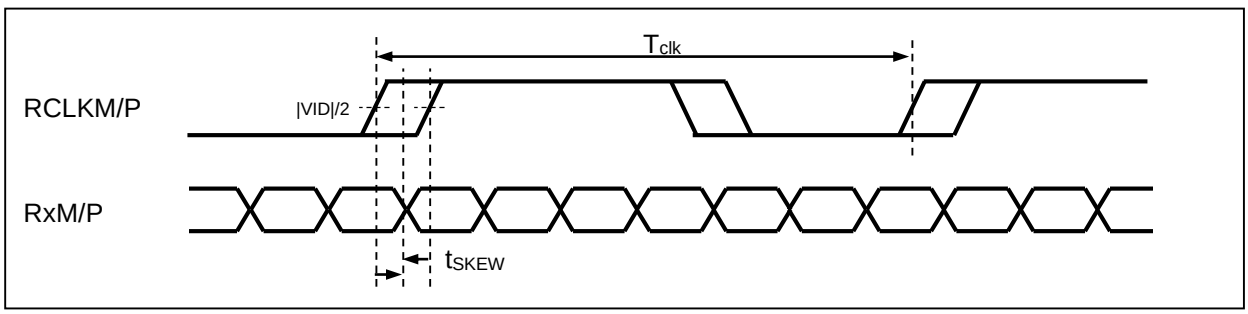


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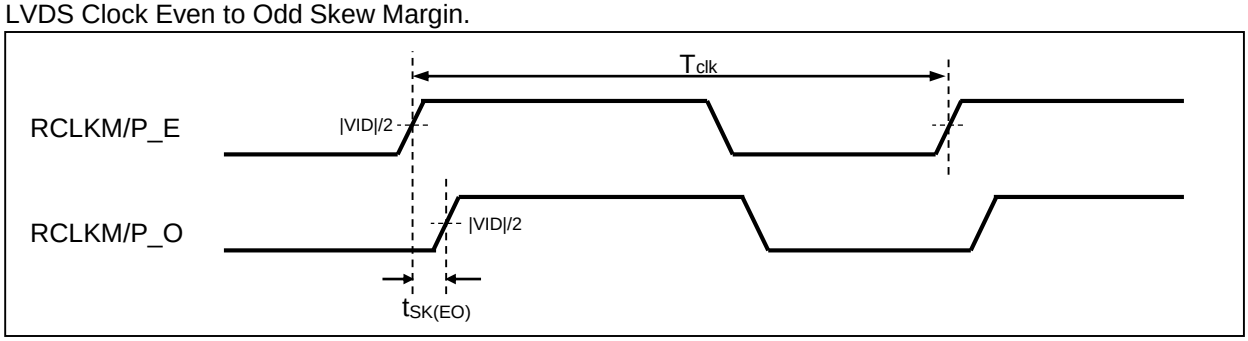
5-3-3. AC Characteristics (2/2)

Parameter	Symbol	Min	Typ	Max	Unit	Notes
LVDS Clock to Data Skew Margin	t_{SKEW}	-300	-	+300	ps	1
Skew Even to Odd port	$t_{SK(EO)}$	-1/7	-	1/7	Tclk	2
Maximum deviation of input clock frequency during SSC	F_{DEV}	-	-	±2.5	%	3
Maximum modulation frequency of input clock during SSC	F_{MOD}		-	150	KHz	

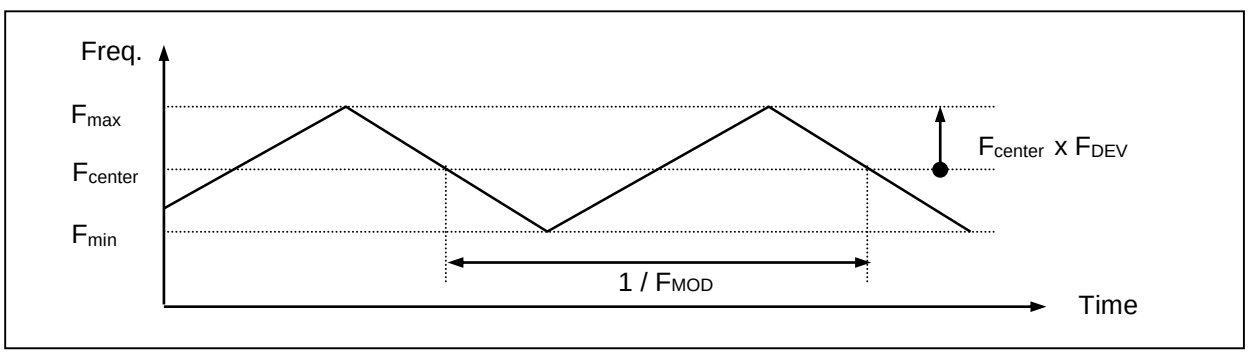
Note:
1. LVDS Clock to Data Skew Margin.



2. LVDS Clock Even to Odd Skew Margin.



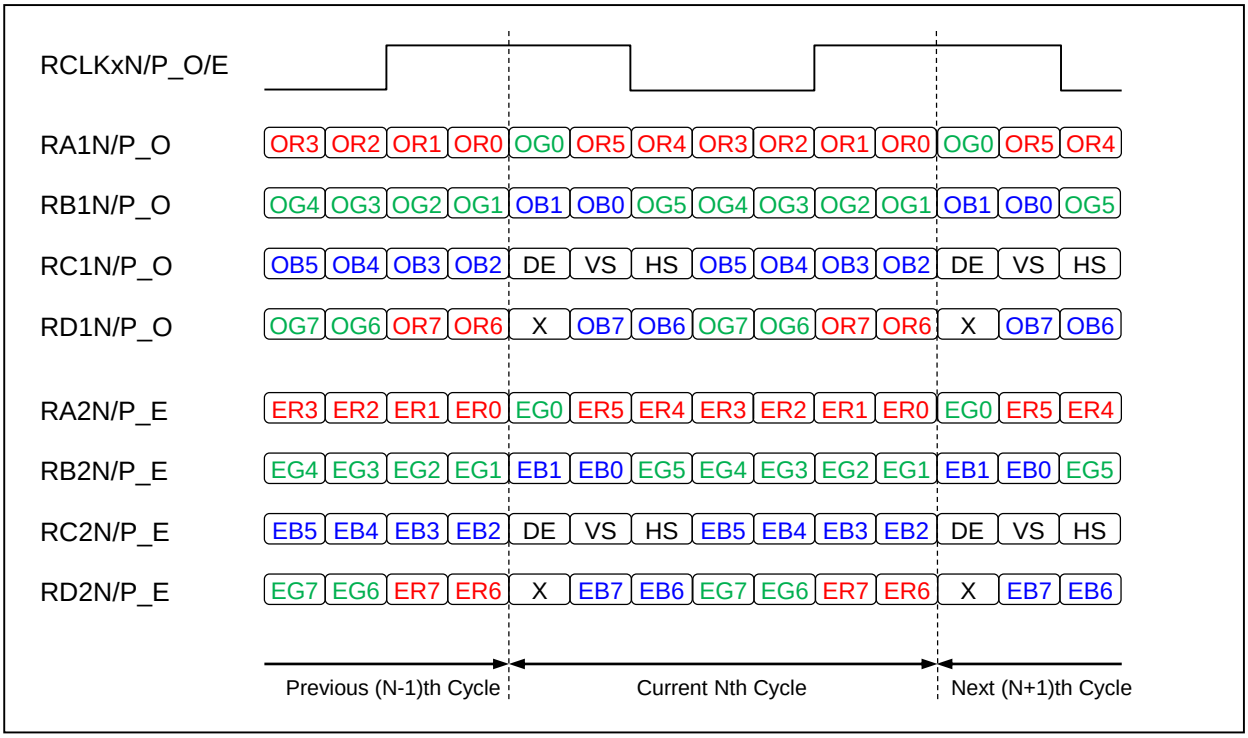
3. Spread spectrum



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5-3-4. LVDS Bit assignment

-. LVDS 2Port 8Bit(VESA Format)



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5-4. Signal Timing Specifications

Table 5-4-1 shows the signal timing required at the input of the LVDS transmitter. All of the interface signal timings should be satisfied with the following specification for normal operation.

Table 5-4-1. SIGNAL TIMING CHARACTERISTICS f_V=60Hz

Parameter		Symbol	Min	Typ	Max	Unit	Note
DCLK	Frequency	f_{CLK}	89.0 (44.5)	89.6 (44.8)	90.2 (45.1)	MHz	( ) : 2port
	Period	t_{CLK}	11.09 (22.17)	11.16 (22.32)	11.23 (22.47)	ns	( ) : 2port
HSYNC	Period	t_{HP}	2040 (1020)	2048 (1024)	2056 (1028)	t_{CLK}	( ) : 2port, Note 2
	Width	t_{WH}	40 (20)	40 (20)	40 (20)		
	Horizontal Valid	t_{HV}	1920 (960)				( ) : 2port
	Horizontal Back Porch	t_{HBP}	40 (20)	40 (20)	48 (24)		
	Horizontal Front Porch	t_{HFP}	40 (20)	48 (24)	48 (24)		
VSYNC	Period	t_{VP}	727	729	732	t_{HP}	
	Width	t_{WV}	2	2	2		
	Vertical Valid	t_{VV}	720				
	Vertical Back Porch	t_{VBP}	2	2	2		
	Vertical Front Porch	t_{VFP}	3	5	8		

Note 1. The electro-optical performance may be influenced by variance of the vertical refresh rates.
2. It should be set to an even number for 2port.

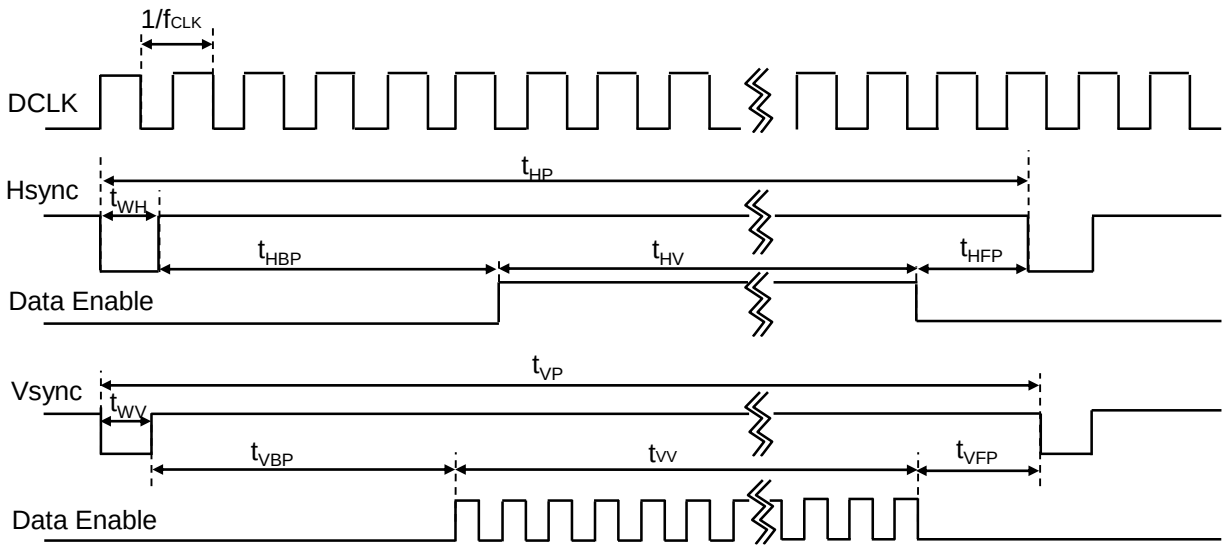


FIG 5-4-1. Signal Timing Waveforms

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5-5. Color Data Reference

The brightness of each primary color(red, green, blue) is based on the 8bit gray scale data input for the color. The higher binary input, the brighter the color. Table 5-5-1. provides a reference for color versus data input.

Table 5-5-1. COLOR DATA REFERENCE

Color		Input Color Data		
		RED	GREEN	BLUE
		MSB LSB	MSB LSB	MSB LSB
		R7 R6 R5 R4 R3 R2 R1 R0	G7 G6 G5 G4 G3 G2 G1 G0	B7 B6 B5 B4 B3 B2 B1 B0
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
	Red (255)	1 1 1 1 1 1 1 1	0 0 0 0 0 0 0 0	0 0 0 0 0 0 0 0
	Green (255)	0 0 0 0 0 0 0 0	1 1 1 1 1 1 1 1	0 0 0 0 0 0 0 0
	Blue (255)	0 0 0 0 0 0 0 0	0 0 0 0 0 0 0 0	1 1 1 1 1 1 1 1
	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
	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
RED	RED (00)	0 0 0 0 0 0 0 0	0 0 0 0 0 0 0 0	0 0 0 0 0 0 0 0
	RED (01)	0 0 0 0 0 0 0 1	0 0 0 0 0 0 0 0	0 0 0 0 0 0 0 0
	…	…	…	…
	RED (254)	1 1 1 1 1 1 1 0	0 0 0 0 0 0 0 0	0 0 0 0 0 0 0 0
	RED (255)	1 1 1 1 1 1 1 1	0 0 0 0 0 0 0 0	0 0 0 0 0 0 0 0
GREEN	GREEN (00)	0 0 0 0 0 0 0 0	0 0 0 0 0 0 0 0	0 0 0 0 0 0 0 0
	GREEN (01)	0 0 0 0 0 0 0 0	0 0 0 0 0 0 0 1	0 0 0 0 0 0 0 0
	...	…	…	…
	GREEN (254)	0 0 0 0 0 0 0 0	1 1 1 1 1 1 1 0	0 0 0 0 0 0 0 0
	GREEN (255)	0 0 0 0 0 0 0 0	1 1 1 1 1 1 1 1	0 0 0 0 0 0 0 0
BLUE	BLUE (00)	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 (01)	0 0 0 0 0 0 0 0	0 0 0 0 0 0 0 0	0 0 0 0 0 0 0 1
	…	…	…	…
	BLUE (254)	0 0 0 0 0 0 0 0	0 0 0 0 0 0 0 0	1 1 1 1 1 1 1 0
	BLUE (255)	0 0 0 0 0 0 0 0	0 0 0 0 0 0 0 0	1 1 1 1 1 1 1 1

※ Note: This document is a preliminary version. For reference in designing customers' products, the latest version should be obtained from LG Display.

5-6. Power Sequence (On / Off)

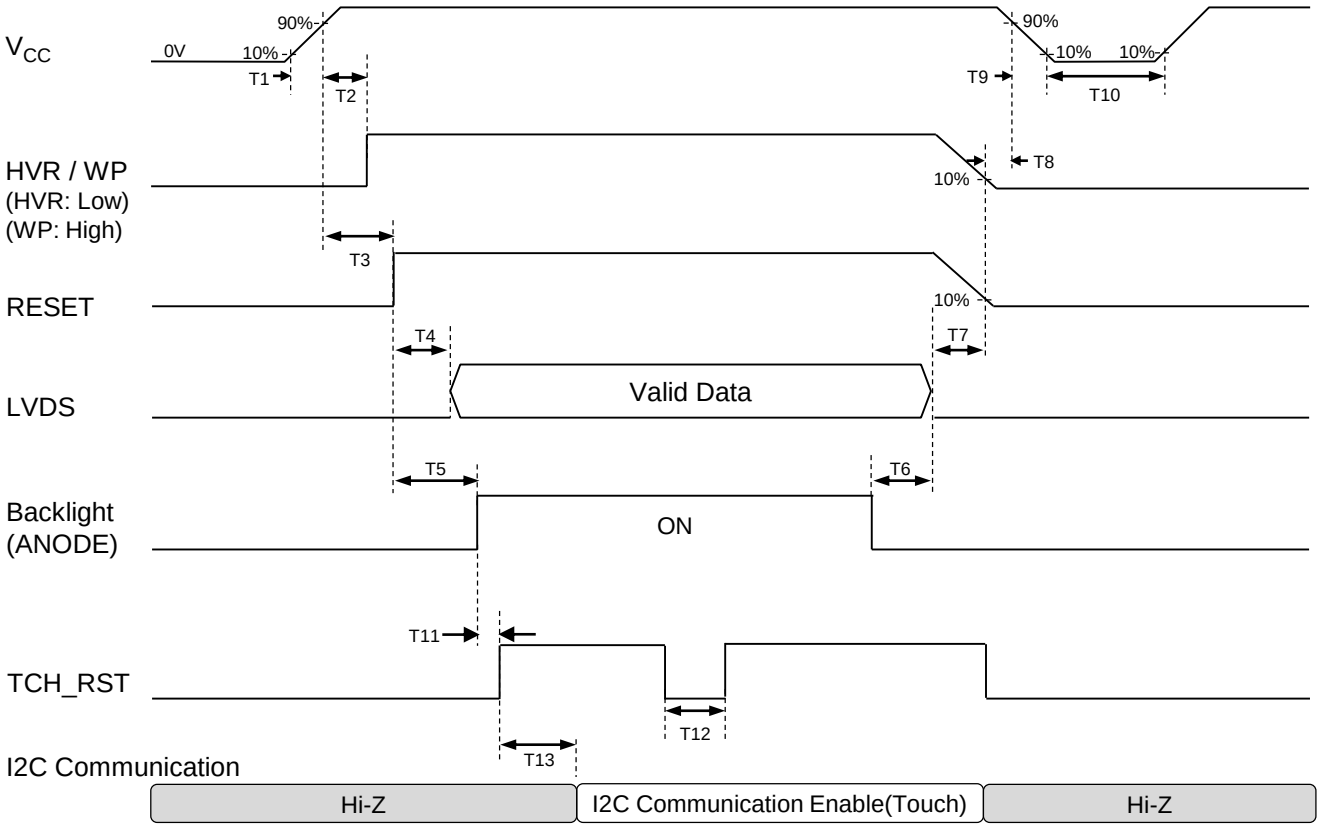


Table 5-6-1. POWER SEQUENCE

Category	Desc.	Parameter	Value			Unit	Note
			Min	Typ	Max		
On Sequence	LCD Power	T1	0.5	-	10	ms	1, 2
	LCD Logic	T2	0	-	10	ms	1
	LCD Reset	T3	1		10	ms	1
	LVDS	T4	10	-	-	ms	1, 3
	Backlight	T5	700	-	-	ms	1, 5
Off Sequence	Backlight	T6	33	-	-	ms	1
	LVDS	T7	1	-	-	ms	1, 3
	LCD Logic	T8	20	-	-	ms	1
	LCD Power	T9	0.5	-	10	ms	1, 2
	LCD Power	T10	500	-	-	ms	1, 2, 4
Touch	Touch Reset	T11	10	-	-	ms	1
	Soft Reset	T12	2	-	5	ms	1
	I2C Comm. For Touch	T13	120	-	-	ms	1

Note 1. Please avoid floating state of interface signal at invalid period.
2. When the interface signal is invalid, be sure to pull down the power supply for V_{CC} to 0V.
3. Do not change HVR status to avoid abnormal display during LCD operation.
4. During the low temperature operation, display looks slow depending on the response speed characteristics of the liquid crystal.
5. Backlight must be turn on after power supply for LCD and interface signal are valid.

※ Note: This document is a preliminary version. For reference in designing customers' products, the latest version should be obtained from LG Display.

6. Touch

6-1. Touch Specifications

Table 6-1-1. General Specifications

Item		Spec.	Note.
General Specification	Touch Panel Technology	Projected Capacitive Touch	
	Sensor Type	In-Cell	AIT
	Multi Touch Points	5 points	
	Active Touch Area [mm]	292.032 x 109.512	[mm]
	Finger Size (min.~max.)	9Φ (6~25Φ)	
	Interface	I2C	
	Touch Block	48 by 20	
	Touch FW version	v 00.03	

Table 6-1-2. Touch Performance

Item			Unit	Spec.			Notes
				Min.	Typ.	Max.	
Touch Performance	Point Accuracy	Center	mm	-	-	1.0	9Φ Finger (w/o Glove)
		Edge	mm	-	-	2.0	
	Linearity	Center	mm	-	-	1.0	9Φ Finger (w/o Glove)
		Edge	mm	-	-	2.0	
	Finger Separation		mm	14	-	-	(6Φ center to center)

Note 1. All kind of specifications and functions are optimized with the below Test condition.
-. Report rate 60Hz@1-finger

※ Note: This document is a preliminary version. For reference in designing customers' products, the latest version should be obtained from LG Display.

Note. Touch Performance measurement

- Test Machine : MIK K9830RP
- Test Tip : 9Φ Slug
- E : 4.5mm(Test Tip Size/2)

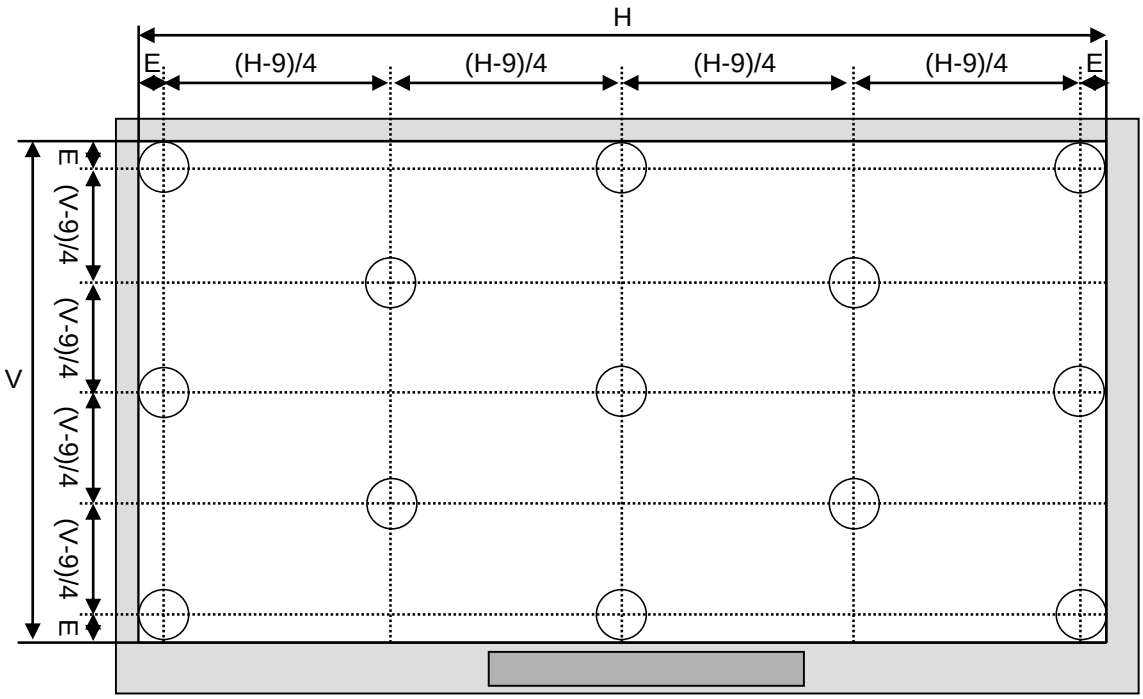


FIG 6-1-1. Accuracy Test

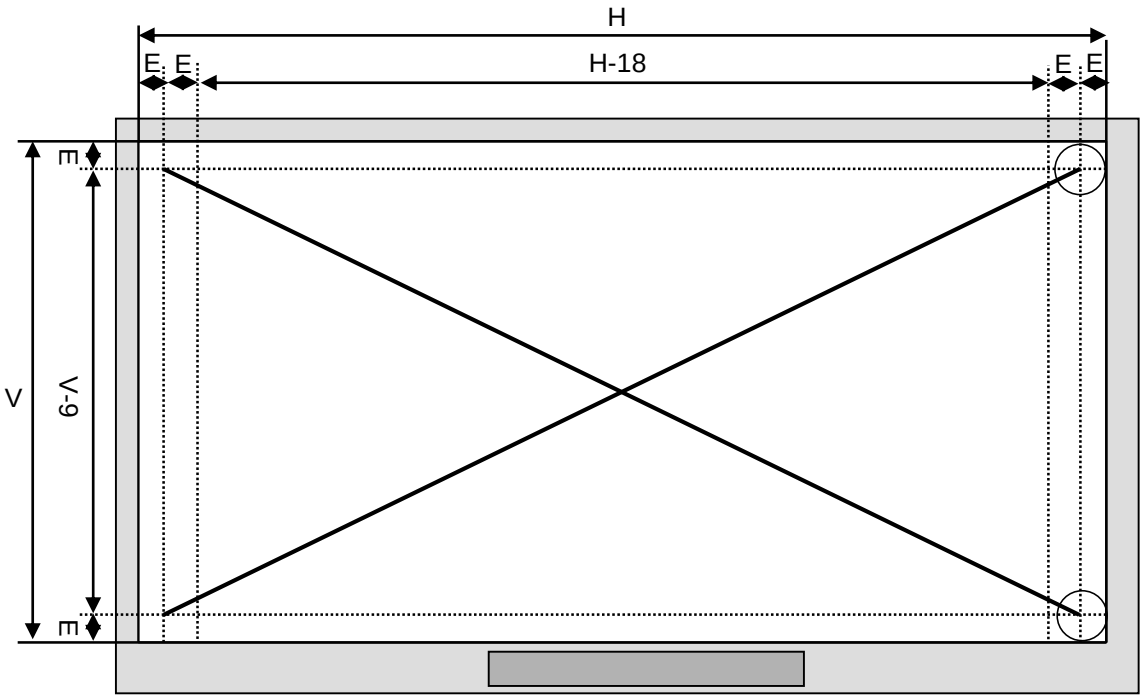


FIG 6-1-2. Linearity Test

※ Note: This document is a preliminary version. For reference in designing customers' products, the latest version should be obtained from LG Display.

7. Electro-optical Characteristics

7-1. Electro-optical Characteristics

Electro-optical characteristics are determined after the unit has been turned on and stable in a dark environment at 25±2°C. The values are specified at an approximate distance 50cm from the LCD surface at a viewing angle of Φ and Θ and equal to 0°. Measured value at the center point of LCD panel after more than 20 minutes while backlight turning on.
Electro-Optical characteristics of certain selected LCD panels are measured at the center point once the selected LCD panels have had their backlights turned on for more than twenty(20) minutes during the mass production stage.
It is presented additional information concerning the measurement equipment and method in FIG 7-1.

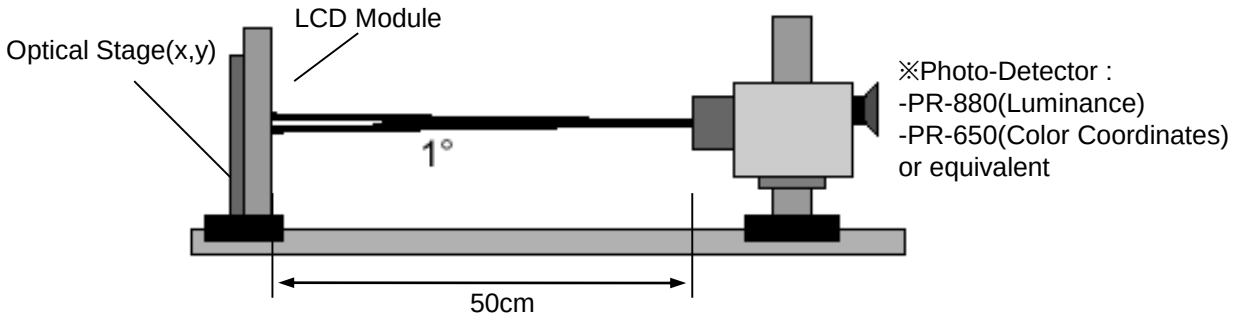


FIG 7-1. Electro-optical Characteristic Measurement Equipment and Method

V_{CC}=3.3V, fv=60Hz, fclk= Typ, I_{LED} = 100mA

Parameter		Symbol	Value			Unit	Equipment	Note
			Min.	Typ.	Max.			
Contrast Ratio (Perpendicular)		CR	1,000	1,400	-		PR-880	1
Surface Luminance, white		L_{WH}	800	1,000	-	cd/m²	PR-880	2
Luminance Uniformity		δ_{WHITE}	80	-	-	%	PR-880	3
		δ_{BLACK}	50	-	-			
Response Time	25℃	Tr+Tf	-	-	25	ms	RD-80S	4,5
	-20℃	Tr+Tf	-	-	200	ms		
	-30℃	Tr+Tf	-	-	500	ms		
Color Gamut	-	-	-	85	-	%	-	
Color Coordinates [CIE1931]	RED	Rx	Typ. -0.030	(0.670)	Typ. +0.030		PR-650	
		Ry		(0.310)				
	GREEN	Gx		(0.270)				
		Gy		(0.635)				
	BLUE	Bx		(0.145)				
		By		(0.065)				
	WHITE	Wx		(0.310)				
		Wy		(0.325)				
Reflection(SCI)		-	-	-	5.5	%	-	
Viewing Angle (CR>10)	x axis, right(ϕ=0°)	θr	-	89	-	degree	EZ-Contrast	6
	x axis, left (ϕ=180°)	θl	-	89	-			
	y axis, up (ϕ=90°)	θu	-	89	-			
	y axis, down (ϕ=270°)	θd	-	89	-			

※ Note: This document is a preliminary version. For reference in designing customers' products, the latest version should be obtained from LG Display.

Note 1. Contrast Ratio(CR) is defined mathematically as :

$$CR = \frac{\text{Gray 255 [White]}}{\text{Gray 0 [Black]}}$$

It is measured at center 1-point.

2. Surface luminance are determined after the unit has been turned on and more than 20minutes after lighting the backlight in a dark environment at 25±2°C. Surface luminance is the luminance value at center 1-point across the LCD surface 50cm from the surface with all pixels displaying white. For more information see the FIG 7-1.

3. White Uniformity & Black Uniformity Measurement(VESA 9poins type)

$$\text{Uniformity} = \frac{\text{Minimum Luminance}}{\text{Maximum Luminance}} \times 100\ (\%)$$

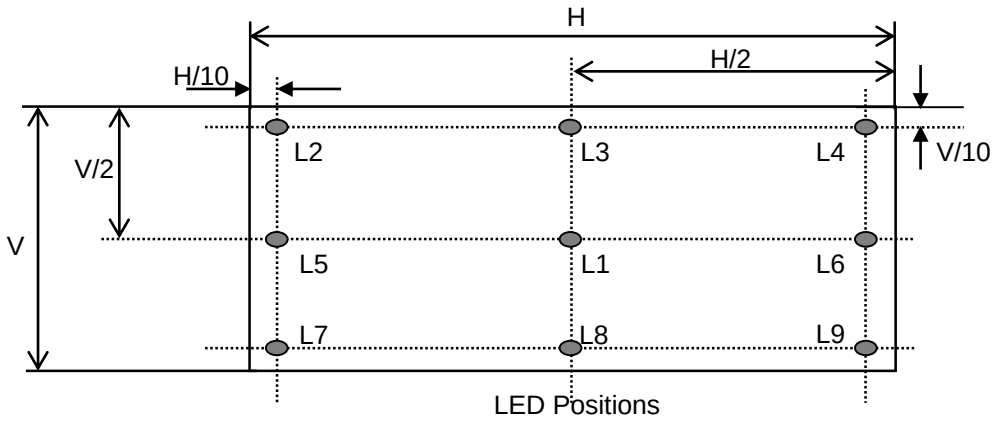


FIG 7-2. 9Points for Luminance Measurement

4. Response time is obtained by measuring the transition time of photo detector output, when input signals are applied to make center point “black” and “white”. For more information, see the FIG 7-4.

5. Low temperature response time measure method
:The LCM has remained at low temperature(0℃ or -20℃ or -30℃)for 30minutes and then kept turning on for 30minutes before measured.
Please note that low temperature response time is not measured and/or managed in mass production.

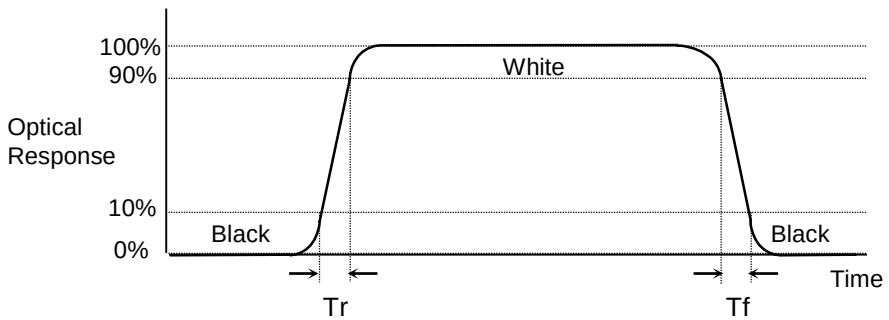


FIG 7-3. Response Time

※ Note: This document is a preliminary version. For reference in designing customers’ products, the latest version should be obtained from LG Display.

6. Viewing angle is the angle at which the contrast ratio is greater than 10. The angles are determined for the horizontal or x axis and the vertical or y axis with respect to the z axis which is normal to the LCD module surface. For more information, see the FIG 7-5.

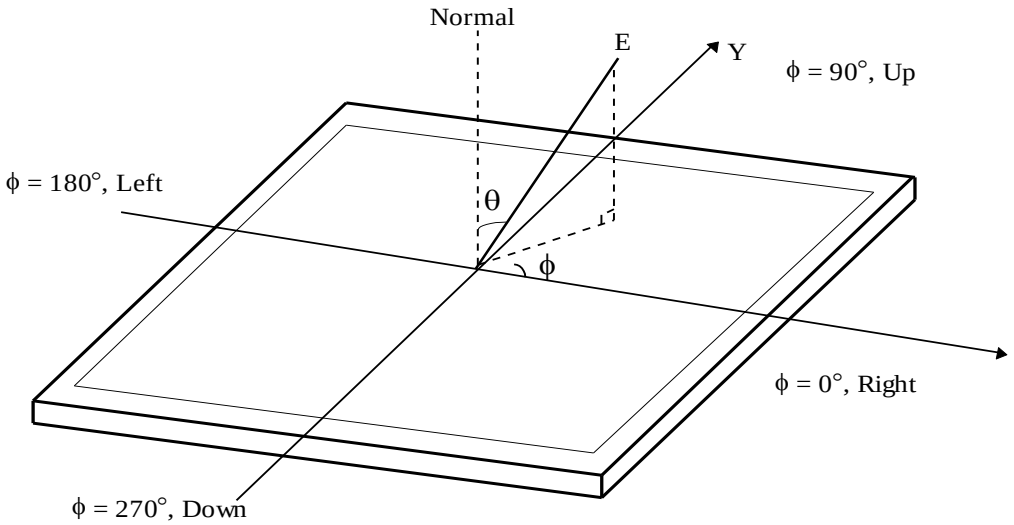


FIG 7-5. Viewing Angle

※ Note: This document is a preliminary version. For reference in designing customers' products, the latest version should be obtained from LG Display.

8. Mechanical Characteristics

The below contents provide general mechanical characteristics for this LCD panel.
In addition the figures in the next page are detailed mechanical drawing of the LCD panel.

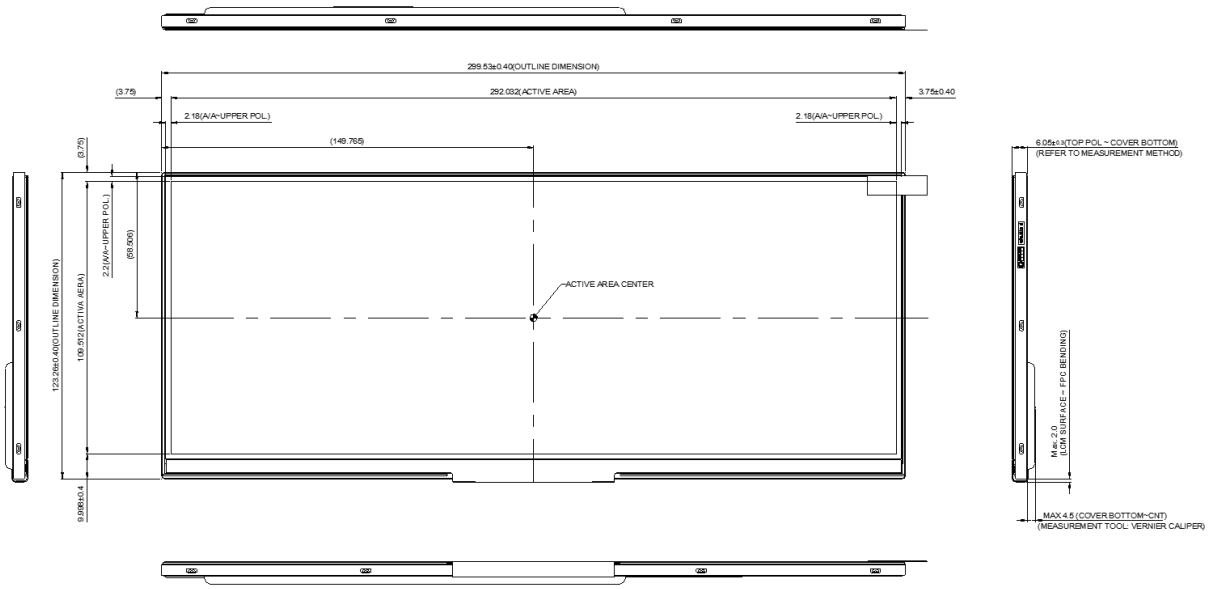
Table 8-1. MECHANICAL CHARACTERISTICS

Parameter	Value	
Outline Dimension	Horizontal	299.53 ± 0.4mm
	Vertical	123.26 ± 0.4mm
	Thickness	6.05 ± 0.3mm
Active Display Area	Horizontal	292.032 ± 0.1mm
	Vertical	109.512 ± 0.1mm
Weight	274 g (Typ.), 284 g (Max.)	

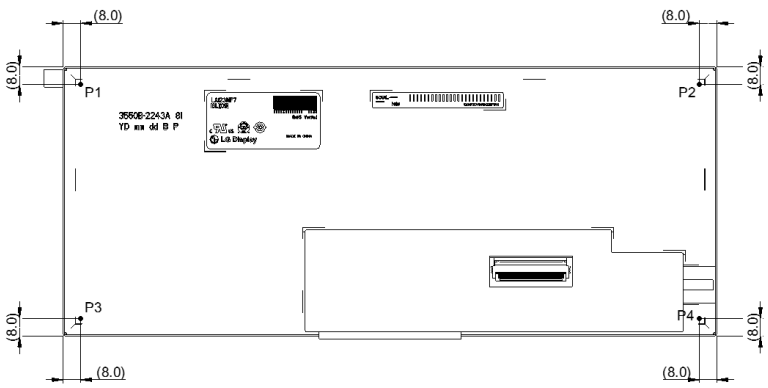
※ Note: This document is a preliminary version. For reference in designing customers' products, the latest version should be obtained from LG Display.

Note. Unit:[mm]

<FRONT VIEW>



※ LCM THICKNESS: 6.05±0.3
- MEASUREMENT TOOL: VERNIER CALIPER OR MICRO METER
- MEASUREMENT METHOD: MEASURE IT FROM TOP POL TO COVER BOTTOM
- MEASUREMENT POINT: P1 ~ P4 (4POINT)

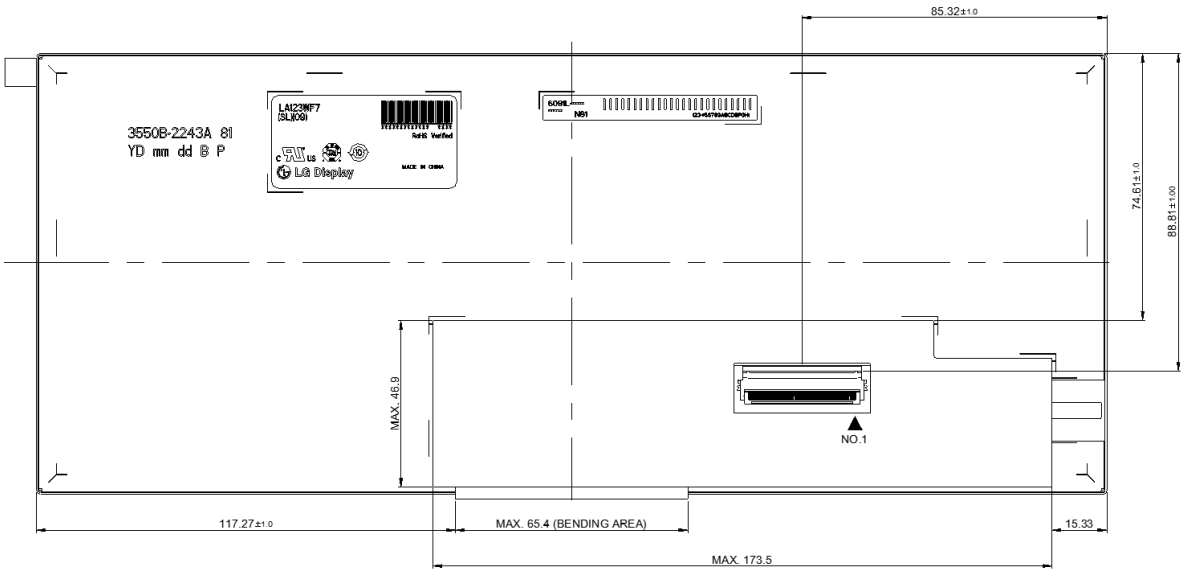


THICKNESS MEASUREMENT POINT (TOP POL~C/B)
(SCALE 1/2)

※ Note: This document is a preliminary version. For reference in designing customers' products, the latest version should be obtained from LG Display.

Note. Unit:[mm]

<REAR VIEW>



NOTE
1. UNSPECIFIED TOLERANCES ARE ±0.3mm.
2. COMPROMISE WITH DESIGNER ON DETAIL MATTERS.
3. ALL MATERIAL SHOULD BE APPLIED ON HALOGEN FREE MATERIAL.

※ Note: This document is a preliminary version. For reference in designing customers' products, the latest version should be obtained from LG Display.

9. Reliability

Table 9-1. ENVIRONMENT TEST CONDITION

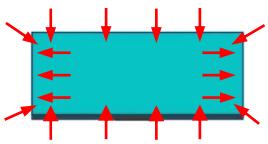
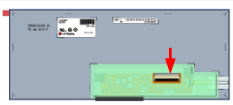
<table>
<tr><th>No</th><th>Test Items</th><th>Test Condition</th><th>Q'ty</th><th>Note</th></tr>
<tr><td>1</td><td>High Temperature Storage Test</td><td>T_a = +95°C, 240h</td><td>3</td><td>1,2</td></tr>
<tr><td>2</td><td>Low Temperature Storage Test</td><td>T_a = -40°C, 240h</td><td>3</td><td>1,2</td></tr>
<tr><td>3</td><td>High Temperature Operation Test</td><td>T_a = +85°C, 240h</td><td>3</td><td>1,2</td></tr>
<tr><td>4</td><td>Low Temperature Operation Test</td><td>T_a = -40°C, 240h</td><td>3</td><td>1,2</td></tr>
<tr><td>5</td><td>High Temperature & Humidity Operation Test</td><td>T_a = +65°C, 90%RH, 240h</td><td>3</td><td>1,2</td></tr>
<tr><td>6</td><td>Temperature Shock Test (Non-Operating)</td><td>T_a=-40°C(30min) ↔ T_a=+95°C(30min.), 240cycles</td><td>3</td><td>1,2</td></tr>
<tr><td>7</td><td>Electro Static Discharge Test</td><td><table><tr><th colspan="4">Condition</th><th colspan="2">Judgment</th></tr><tr><td>Panel Surface</td><td>Operating</td><td>330pF, 2kΩ, Air</td><td>±2kV</td><td>Grade B</td></tr><tr><td>User Connector Pin</td><td>Non-Operating</td><td>200pF, 0Ω, Contact</td><td>±0.2kV</td><td>Grade A</td></tr></table></td><td>1</td><td>3</td></tr>
<tr><td>8</td><td>Mechanical Shock Test (Non-Operating)</td><td>Half Sine Wave, 50G, 11ms, 3 times
One in each opposite direction of each perpendicular axis</td><td>3</td><td>4</td></tr>
<tr><td>9</td><td>Vibration Test (Non-Operating)</td><td>10Hz to 50Hz, 5.0G, 1mm p-p, logarithm sweep
for 1min/cycle, 30 sweeps per axis (only y axis)</td><td>3</td><td>4</td></tr>
</table>

※ Note: This document is a preliminary version. For reference in designing customers' products, the latest version should be obtained from LG Display.

Note 1. T_a = Ambient Temperature

2. After 24 hours later test has been done, a display is rejected when one of the following defects occurs:
   - Optical and Electrical defects as specified in the test specification.
     Only For Functional Performance as LED Brightness Reduction or Wx, Wy Shift,
     Exclude Cosmetic, Wrinkle
   - reduction of the original contrast ratio perpendicular of more than 30%
   - doubling of specified max. total consumption
   - reduction of the original min. brightness from LED more than 50%
   - Wx, Wy color coordinates change is greater than ±0.025 of the initial state

3. Electro Static Discharge Test measure method.
   Equipment: ESS-2000 or equivalent level device (Panel Surface Test)
   ESS-608 or equivalent level device (User Connector Pin Test)

	Discharging Point	Interval	Test Conditions
Panel Surface (Air)		**1**sec	5 times of electric discharge to arbitrary points in the central part of the panel
User Connector Pin (Contact)			5 times of electric discharge to per pin

※ ESD Criteria

Grade	Description	Hardware Damage
Grade A	Normal Operating.	No Damage
Grade B	Temporary abnormal display but recover within 3 seconds.	No Damage
Grade C	Temporary abnormal display. It takes longer to recover or after On/Off.	No Damage
Grade D	Display is not recovered even after long time passed or after On/Off.	Damage

4. After this test has been done, the specimen should function normally without any fatal defect.
   (no picture, line defect, out of synchronization)

※ Note: This document is a preliminary version. For reference in designing customers' products, the latest version should be obtained from LG Display.

10. International Standards

10-1. Safety

a) UL **62368-1**, UL LLC.
Audio/video, Information and Communication Technology Equipment - Safety Requirements
b) CAN/CSA C22.2 No.**62368-1**, Canadian Standards Association (CSA).
Audio/video, Information and Communication Technology Equipment - Safety Requirements
c) EN **62368-1**, European Committee for Electrotechnical Standardization (CENELEC)
Audio/video, Information and Communication Technology Equipment - Safety Requirements
d) IEC **62368-1**, The International Electro-technical Commission(IEC).
Audio/video, Information and Communication Technology Equipment - Safety - Safety Requirements.
e) Flammability test for determination of burning behaviour of interior materials in motor vehicles.
- ISO 3795, International Organization for Standardization
Road vehicles, and tractors and machinery for agriculture and forestry – Determination of burning behaviour of interior materials
- DIN 75200, Deutsche Industric Normen
Determination of burning behaviour of interior materials in motor vehicles.
- FMVSS 302, Federal Motor Vehicle Safety Standards
Flammability of Interior Materials

10-2. Environment

a) RoHS, Directive 2011/65/EU of the European Parliament and of the council of 8 June 2011

※ Note: This document is a preliminary version. For reference in designing customers' products, the latest version should be obtained from LG Display.

11. Packing

11-1. Designation of the Label

a) Lot Mark

A	B	C	D	E	F	G	H	I	J	K	L	M

A,B,C : SIZE(INCH)
D : YEAR
E : MONTH
F ~ M : SERIAL NO.

Note

1. YEAR

Year	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025
Mark	F	G	H	J	K	L	M	N	P	Q

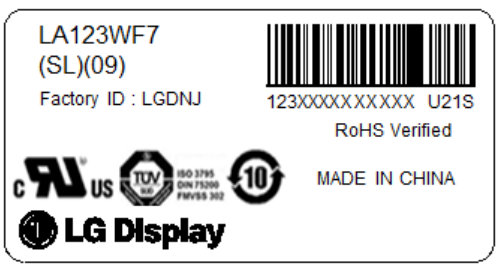
2. MONTH

Month	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Mark	1	2	3	4	5	6	7	8	9	A	B	C

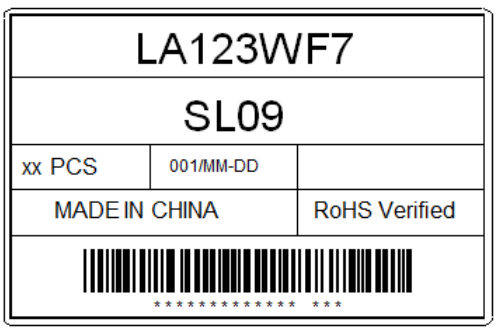
b) Location of Lot Mark

Serial No. is printed on the label. The label is attached to the backside of the LCD module.
This is subject to change without prior notice.

ID LABEL



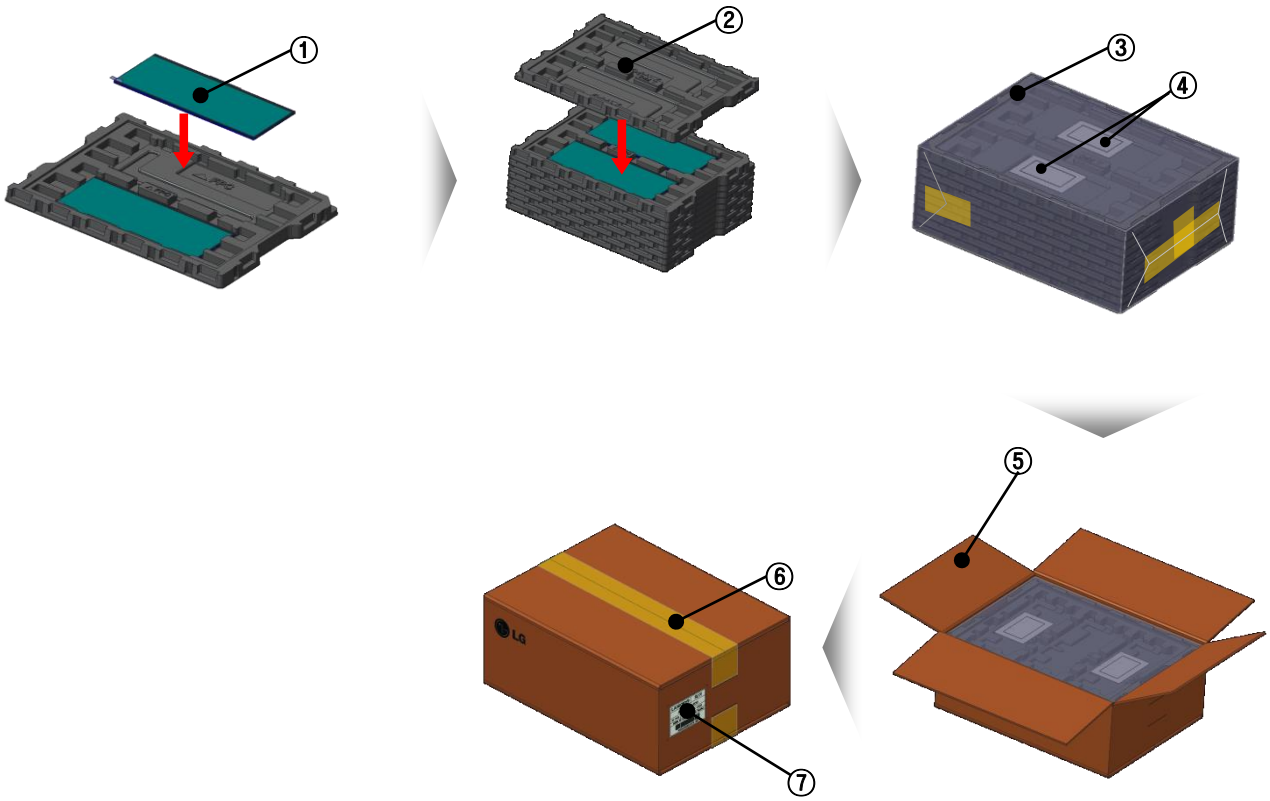
BOX/PALLET LABEL



※ Note: This document is a preliminary version. For reference in designing customers' products, the latest version should be obtained from LG Display.

11-2. Packing Form

a) Package quantity in one box : 18 pcs
b) Box Size : 478 mm × 365 mm × 195 mm



NO.	Description	Material
1	Module	18pcs/1 Box
2	Tray	PET
3	Bag	PE
4	Desiccant	Calcium Chloride
5	Box	Corrugated Board
6	Tape	OPP
7	Box Label	ART Paper

※ Note: This document is a preliminary version. For reference in designing customers' products, the latest version should be obtained from LG Display.

12. PRECAUTIONS

Please pay attention to the following when you use this LCD panel.

12-1. MOUNTING PRECAUTIONS

(1) You should design the assembling structure so that uneven force(ex. twisting stress) is not applied to the LCD panel.
(2) Please attach a transparent protective plate to the surface in order to protect the polarizer. Transparent protective plate should have sufficient strength in order to resist external force.
(3) You should adopt radiation structure to satisfy the temperature requirements hereunder.
(4) Acetic acid type and chlorine type materials are not desirable because the former generates gas corroding the polarizer at high temperature and the latter causes circuit breaks by electro-chemical reaction.
(5) Do not touch, push or rub the exposed polarizers with glass, tweezers or anything harder than HB pencil lead. And please do not rub with dust clothes and chemical treatment.
Do not touch the surface of polarizer with a bare hand or greasy cloth.
(Some cosmetics deteriorate the polarizer.)
(6) When the surface becomes dusty, please wipe gently with absorbent cotton or other soft materials like chamois soaked with petroleum benzene. Normal-hexane is recommended for cleaning the adhesives used to attach front / rear polarizers. Do not use acetone, toluene and alcohol because they cause chemical damage to the polarizer.
(7) Wipe off saliva or water drops as soon as possible. Their long time contact with polarizer causes deformations and color fading.
(8) Do not touch, push the circuit component on FPC .
(9) The ground of a FPC should be connected to electrical ground of your system.
(10) The metal case of a module should be connected to electrical ground of your system.

12-2. OPERATING PRECAUTIONS

(1) The spike noise causes the mis-operation of circuits. It should be lower than following voltage :
V=±200mV(Over and under shoot voltage)
(2) Response time depends on the temperature.(In lower temperature, it becomes longer.)
(3) Be careful for condensation when sudden temperature change occurs. Condensation damages polarizer or electrical contact parts. And after fading condensation, smear or spot will occur.
(4) When a fixed patterns has been displayed for a long time, its remnant image is likely to appear on the screen.
(5) LCD panel 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.
(6) 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.

※ Note: This document is a preliminary version. For reference in designing customers' products, the latest version should be obtained from LG Display.

12-3. ELECTROSTATIC DISCHARGE CONTROL

Since a LCD panel is composed of electronic circuits, it is not resistant to electrostatic discharge. Make certain that handling persons are connected to ground through wrist band etc. And don't touch interface pin directly.

12-4. PRECAUTIONS FOR STRONG LIGHT EXPOSURE

Strong light exposure causes degradation of polarizer and color filter.

12-5. STORAGE

When storing LCD panel as spares for a long time, the following precautions are necessary.
(1) Store them in a dark place. Do not expose the LCD panel to sunlight or fluorescent light.
Keep the temperature between 5°C and 35°C at normal humidity.
(2) The polarizer surface should not come in contact with any other object.
It is recommended that they be stored in the container in which they were shipped.

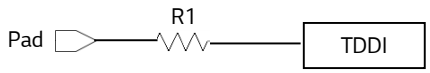
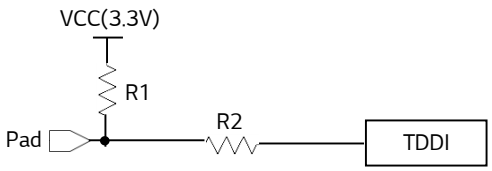
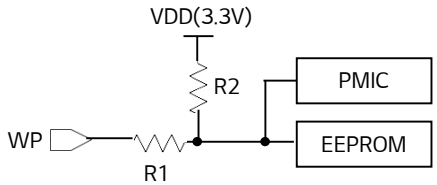
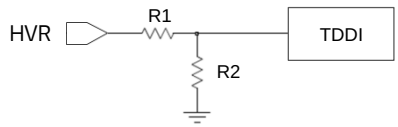
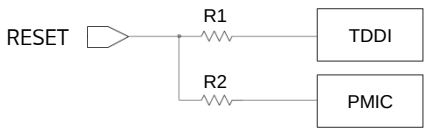
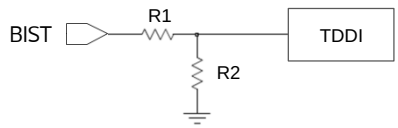
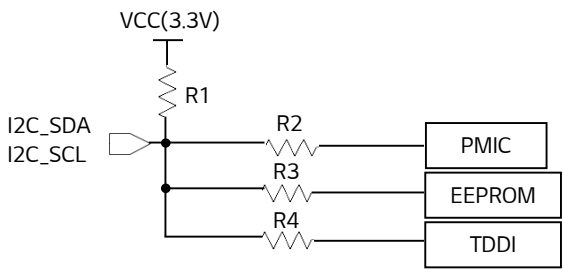
12-6. HANDLING PRECAUTIONS FOR PROTECTION FILM

(1) The protection film is attached to the bezel with a small masking tape or a double side tape.
When the protection film is peeled off, static electricity is generated between the film and polarizer.
This should be peeled off slowly and carefully by people who are electrically grounded and with well ion-blown equipment or in a substantially similar condition, etc.
(2) When the LCD panel with protection film attached is stored for a long time, sometimes there remains a very small amount of glue still on the bezel after the protection film is peeled off.
(3) When the glue remains on the bezel surface or its vestige is recognized,
please wipe them off with absorbent cotton waste or other soft material like chamois soaked with normal-hexane.
(4) When the glue remains on polarizer surface or its vestige is recognized,
please wipe them off with absorbent cotton waste or other soft material like chamois soaked with normal-hexane.

※ Note: This document is a preliminary version. For reference in designing customers' products, the latest version should be obtained from LG Display.

APPENDIX- I

■ I/O Equivalent Circuits

Pin No	Symbol	I/O	Description	Note
17, 20	TCH_INT TCH_RST	I		R1: 0Ω
18, 19	TCH_SDA TCH_SCL	I/O		R1: 4.7kΩ R2: 0Ω
22	WP	I		R1: 0Ω R2: 4.7kΩ
24	HVR	I		R1: 1.1kΩ R2: 100kΩ
25	RESET	I		R1: 0Ω R2: 0Ω
26	NC (LGD Internal Test Pin, BIST)	I		R1: 0Ω R2: 4.7kΩ
28, 29	NC (LGD Internal Test Pin,I2C_SDA, I2C_SCL)	I/O		R1: 4.7kΩ R2: 0Ω R3: 0Ω R4: 0Ω

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APPENDIX- II

■ Thermistor Characteristics (NCP15XH103F0SRC)

Note 1. The display module shall incorporate a NTC thermistor surface mounted to the display circuit board. The user of LCD module can utilize this thermistor for some special purpose. For example, the user can measure display temperature from the thermistor and then turn off backlight when LCD module temperature exceeds maximum rating.

2. $R_{thermistor}$ in the table is the feature of the thermistor by itself, and R_{THER} is measured value in the LCM. Customers should refer to the value of R_{THER} for LED derating.
3. $R_{thermistor}$ tolerance is ±1% at 25℃.

℃ (Ta)	$R_{thermistor}$ [kΩ] (Thermistor)	R_{THER} [kΩ] (NTC_Display Thermistor)
-40	195.65	
-35	148.17	
-30	113.35	
-25	87.56	
-20	68.24	
-15	53.65	
-10	42.51	
-5	33.89	
0	27.22	
5	22.02	
10	17.93	
15	14.67	
20	12.08	
25	10.00	
30	8.32	
35	6.95	
40	5.83	
45	4.92	
50	4.16	
55	3.54	
60	3.01	
65	2.59	
70	2.23	
75	1.93	
80	1.67	
85	1.45	

It will be updated next version

※ Note: This document is a preliminary version. For reference in designing customers' products, the latest version should be obtained from LG Display.