

Product Specification

**SPECIFICATION
FOR
APPROVAL**

- () Preliminary Specification
- (●) Final Specification

Title	15.4" WU (1920 X RGB X 1200) TFT- LCD
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BUYER	Tesla
MODEL	

SUPPLIER	LG Display Co., Ltd.
MODEL	LA154WU1
SUFFIX	SL01

SIGNATURE	DATE
/	_____
/	_____
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**Please return 1 copy for your confirmation
With your signature and comments.**

**Product Engineering Dept.
LG Display Co., Ltd**

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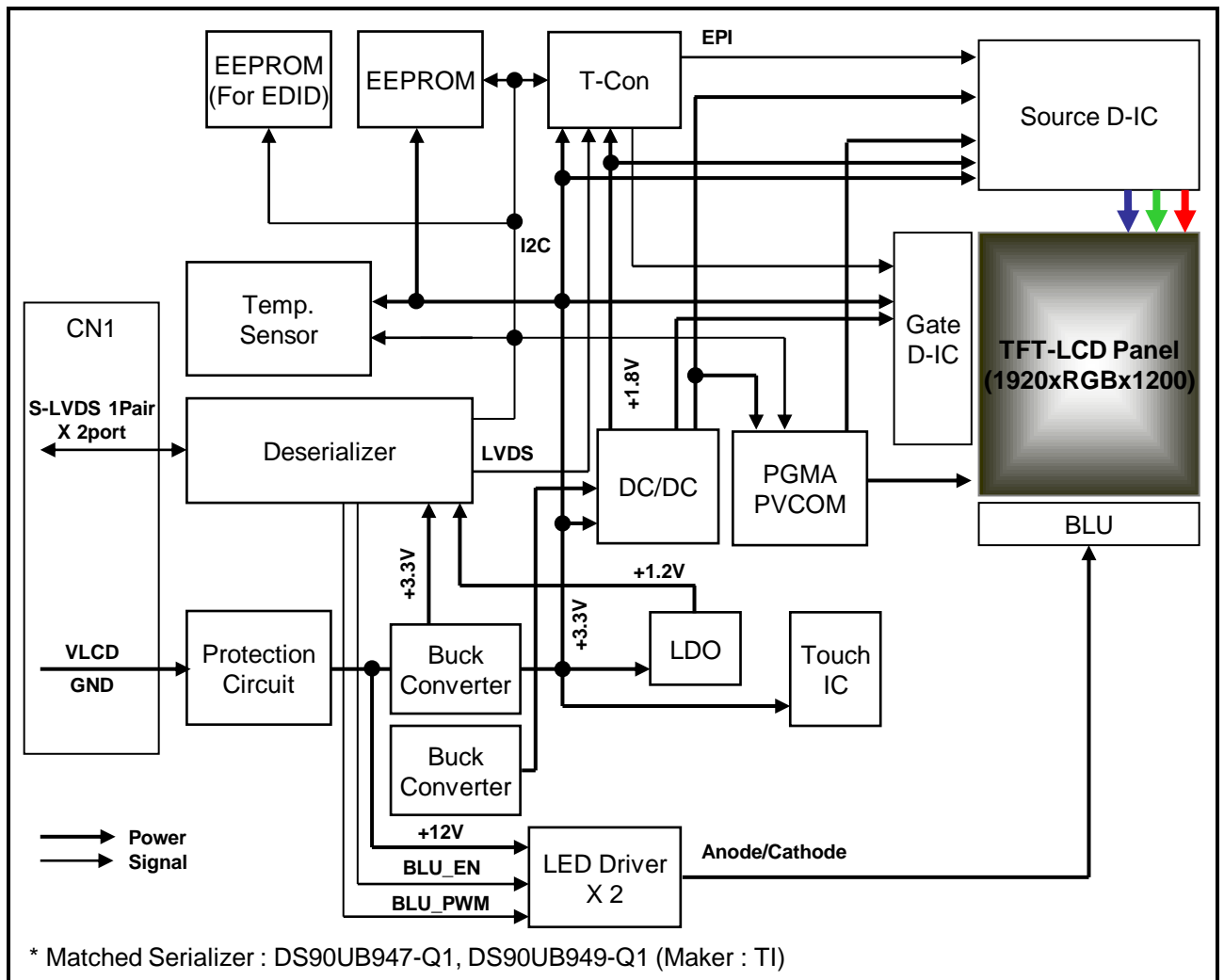
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1. Summary

This module utilizes amorphous silicon thin film transistors and a 16:10 aspect ratio. The 15.4" active matrix liquid crystal display allows 16,777,216 colors to be displayed by Digital RGB interface is available. The application is CID(Center Information Display) for the vehicle.

2. Features

- Utilizes a panel with a 16:10 aspect ratio.
- The 15.4" screen produces a high resolution image that is composed of 2,304,000 pixel elements in a stripe arrangement.
- By adopting 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 of 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.



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3. General Description

Active Screen Size	15.4 inches diagonal
Outline Dimension	341.12 mm (H) x 219.14 mm (V) (Typ.)
Pixel Pitch (Dot pitch x 3)	0.1722 mm x 0.1722 mm (1 Dot : 0.0574 mm x 0.1722 mm)
Pixel Format	1920 horiz. by 1200 vert. Pixels, RGB stripe arrangement
Color Depth	8bit(D), 16.7M colors
Luminance, White	Typ. 800cd/m ² / Min. 640cd/m ² (Center 1 point, PR-740)
Viewing Angle (CR>10)	Viewing angle free (R/L 178 (Min.), U/D 178 (Min.))
Power Consumption	Total 23.52 W (Typ.)
Weight	830 g (Typ.), 850 g (Max.)
Display Mode	Transmissive mode, Normally Black
Surface Treatment	Hard coating(3H), (Glare Type)
Backlight Type	LED

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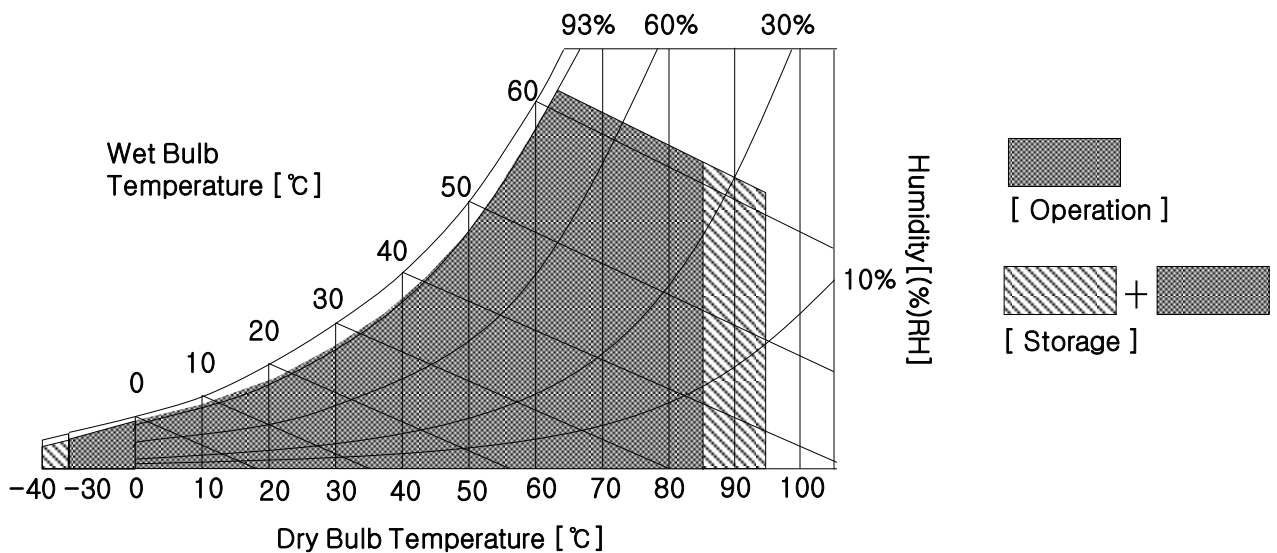
4. Absolute Maximum Ratings

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

Table 1. ABSOLUTE MAXIMUM RATINGS

Parameter	Symbol	Value		Unit	Note
		Min	Max		
Power Supply Voltage	V _{LCD}	-0.3	18	V	1
Input Signal Voltage	V _{LVDS}	-0.3	2.75	V	2
Storage Temperature	T _{ST}	-40	95	°C	3
Operating Temperature	T _A	-30	85	°C	3,4,5

- Note 1. The system should supply enough current for TFT LCD module's stable operation at -30~+85°C.
 2. DOUT0_P, DOUT0_N, DOUT1_P, DOUT1_N
 3. Temperature and relative humidity range are shown in the figure below.
 Wet bulb temperature should be Max. 62°C. Condensation of dew must be avoided, because it may cause electrical current leakage, and deterioration of performance and quality.
 4. The operating temperature means that LCD Module guarantees operation of the circuit.
 All the contents of Electro-optical specifications are guaranteed under the room temperature condition.
 5. This temperature is ambient temperature with regard to the heat which is generated under operation of circuit and backlight on. (reference value)



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5. Electrical Specifications

5-1. Electrical Characteristics

Table 2. LCD DRIVING CIRCUIT ELECTRICAL CHARACTERISTICS

Parameter		Symbol	Value			Unit	Note
			Min	Typ	Max		
Power Supply Voltage		V _{LCD}	10.8	12.0	13.2	V	
Power Supply Current	2 by 2 Pixel	I _{LCD}	1.49	1.86	2.23	A	1
	Mosaic		1.46	1.83	2.20	A	
	White		1.57	1.96	2.35	A	
Power Consumption	Mosaic	P _{LCD}	-	21.96	26.35	W	2
	White		-	23.52	28.22	W	
Rush Current		I _{RUSH}	-	-	4.0	A	3
Input Signal Voltage (Deserializer)		V _{TH}	-	-	50	mV	4, 5
		V _{TL}	-50	-	-	mV	
		V _{ID}	100	-	-	mV	
		V _{CM}	-	2.1	-	V	

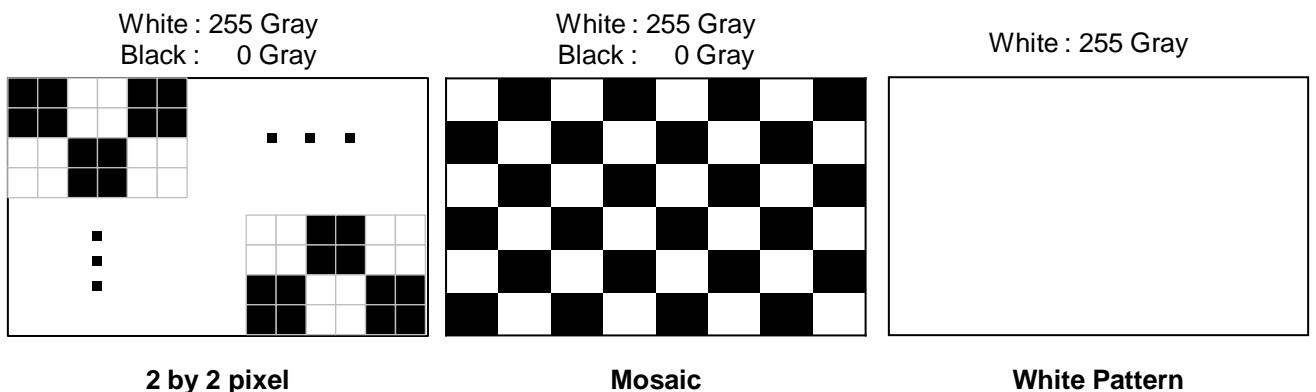
Note 1. The specified current and power consumption are under the V_{LCD}=12V, T_a=25 ± 2°C, f_v=60Hz condition whereas 2 by 2 pixel and white pattern are displayed and f_v is the frame frequency.

2. P_{LCD}(Typ) = I_{LCD}(Typ)*V_{LCD}(Typ), P_{LCD}(Max) = I_{LCD}(Max)*V_{LCD}(Typ) @ White pattern.

3. The duration of rush current is about 2ms and rising time of power input is 0.5ms (min.).
(V_{LCD}=12V, T_a=25 ± 2°C, f_v=60Hz)

4. The recommended operating conditions show the ranges in which the device can operate normally. Operation beyond the limit of the recommended operation conditions is not assured, even though operating conditions are within the limit of the maximum ratings.

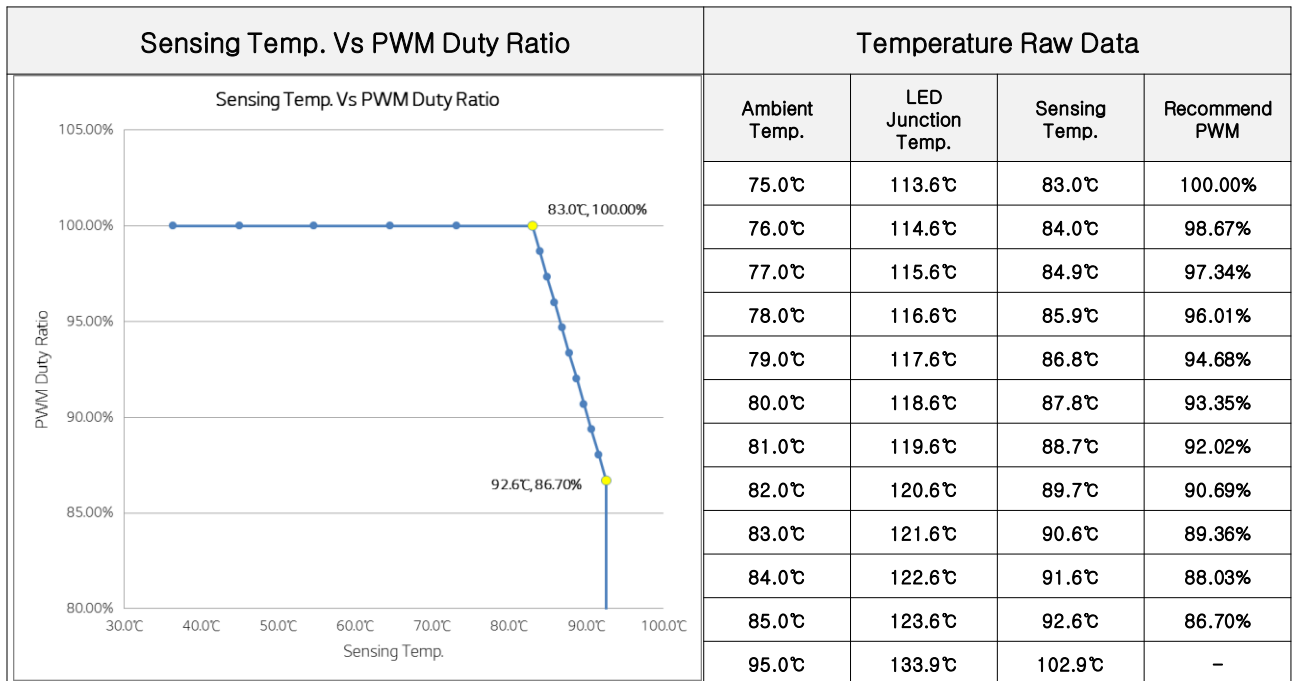
5. Input Signal : LVDS 2pair



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Table 3. BACKLIGHT ELECTRICAL CHARACTERISTICS

Parameter		Symbol	Values			Unit	Note
			Min	Typ	Max		
LED Dimming	Dimming Range	Dimming	0.4	-	100	%	On Duty Ratio
	Dimming Frequency	F_{PWM}	100	-	1000	Hz	
Life Time			20,000	-	-	Hrs	2

Note 1. The acceptable PWM frequency varies with environmental temperature(refer to the picture below).



2. The life time is determined as the time at which brightness of LED is 80% compare to that of initial value at the typical LED current.

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5-2. Interface Connections

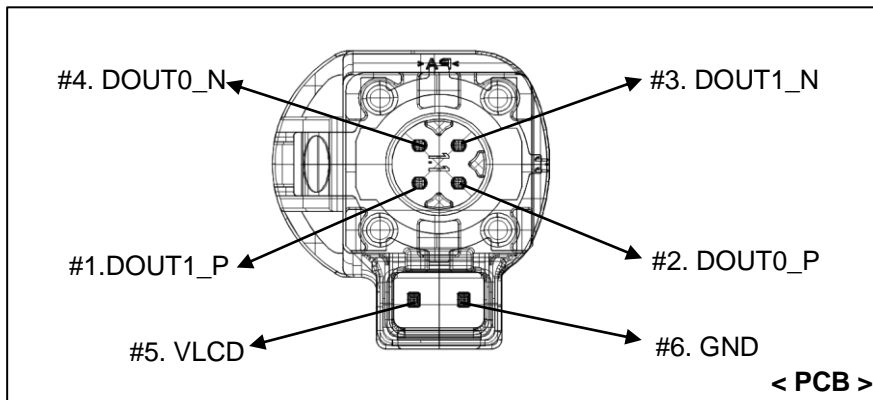
This LCD module employs a kind of interface connection, user connector(CN1) is used for power supply and LVDS 1pair 2port signal connection.

5-2-1. User Connector Pin Configuration

The CN1 part name is 99S11D-40MA5-D manufactured by Rosenberger.

Table 4-1. USER CNT(CN1) PIN CONFIGURATION

Pin No	Name	I/O	Description	Note
1	DOUT1_P	I	LVDS Differential Signal Port2+	1
2	DOUT0_P	I	LVDS Differential Signal Port1+	
3	DOUT1_N	I	LVDS Differential Signal Port2-	
4	DOUT0_N	I	LVDS Differential Signal Port1-	
5	VLCD	I	Power Supply Voltage	
6	GND	I	Ground	



Note 1. Equivalent Circuits.

Pin No	I/O	Description	Note
1~4	I		

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5-3. Signal Timing Specifications

This is the signal timing required at the input of the User connector. All of the interface signal timing should be satisfied with the following specifications for its proper operation..

Table 5. SIGNAL TIMING CHARACTERISTICS (fv=60Hz)

Parameter		Symbol	Min	Typ	Max	Unit	Note
DCLK	Frequency	f_{DCLK}	149.37	154.00	158.92	MHz	
	Period	t_{DCLK}	6.29	6.49	6.69	ns	
Horizontal	Total Period	t_H	2024	2080	2136	t_{DCLK}	
	Display Area Period	t_{HDISP}	1920	1920	1920		
Blank	Front Porch	t_{HFP}	-	48	-		
	Sync Width	t_{HSYNC}	-	32	-		
	Back Porch	t_{HBP}	-	80	-		
	Total Period	t_{HB}	104	160	216		
	Total Period	t_V	1230	1235	1240		
Vertical	Display Area Period	t_{VDISP}	1200	1200	1200		
Blank	Front Porch	t_{VFP}	-	3	-		
	Sync Width	t_{VSYNC}	-	6	-		
	Back Porch	t_{VBP}	-	26	-		
	Total Period	t_{VB}	30	35	40		

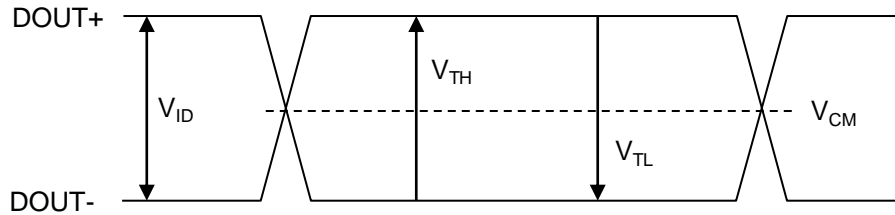
Note:

1. The performance of the electro-optical characteristics may be influenced by variance of the vertical refresh rates.
2. Vertical refresh rates : 60Hz. (If frame rate is changed, flicker or luminance change could occur.)
3. Timing should be in spec within all operating temperature range.
4. Need to discuss with LGD if system timing is different with LGD recommendation.
5. When no signal, screen will run Black.
6. For operation, it is not allowed to change timing(DCLK frequency, Horizontal/Vertical timing).
7. This timing is for 1port.

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5-3. LVDS Signal Specifications

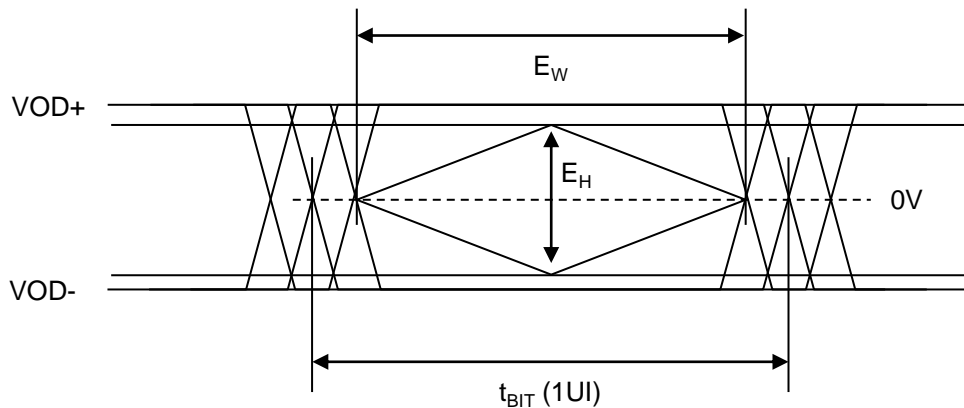
5-3-1. Input LVDS signal DC Characteristics



Parameter	Symbol	Value			Unit	Notes
		Min	Typ	Max		
Differential Threshold High Voltage	V_{TH}	-	-	50	mV	
Differential Threshold Low Voltage	V_{TL}	-50	-	-	mV	
Input Differential Threshold	V_{ID}	100	-	-	mV	
Differential Common-mode Voltage	V_{CM}	-	2.1	-	V	

5-3-2. CML Output AC Characteristics

This is equalized LVDS output from deserializer.



Parameter	Symbol	Value			Unit	Notes
		Min	Typ	Max		
Differential Output Eye Opening Width	E_W	0.4	-	-	UI	
Differential Output Eye Height	E_H	300	-	-	mV	

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5-5. Color Data Reference

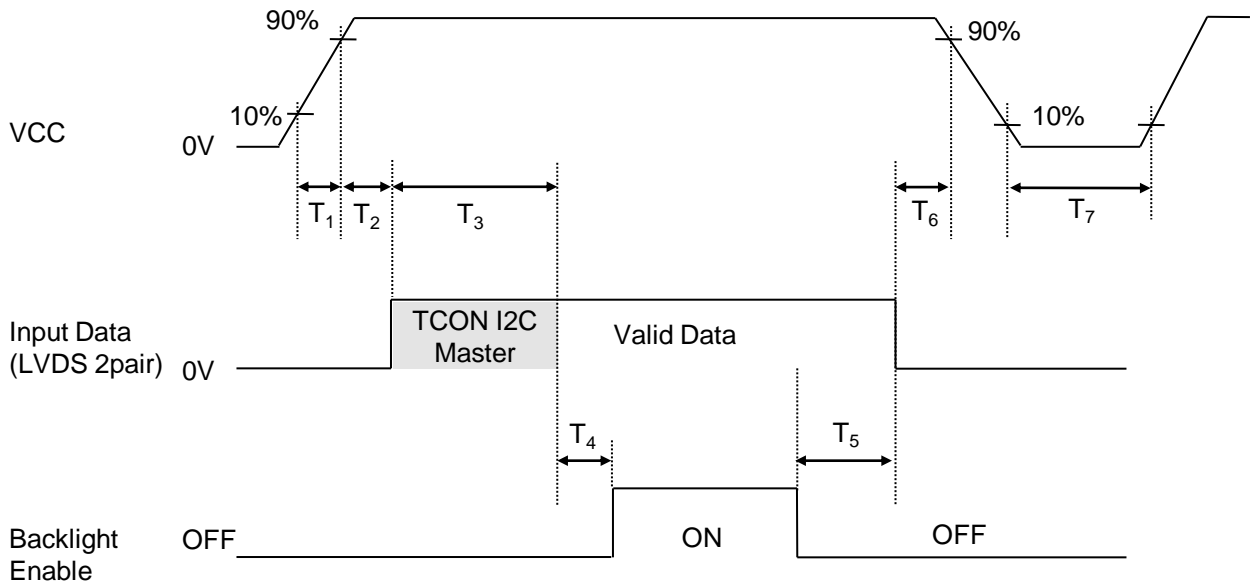
The brightness of each primary color (red, green, blue) is based on the 8bit gray scale data input for the color. The higher binary input, the brighter the color. Table 6 provides a reference for color versus data input.

Table 6. 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

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5-6. Power Sequence

For LCD's normal operation, it is recommended to keep below power supply sequence.


Table 7. POWER SEQUENCE

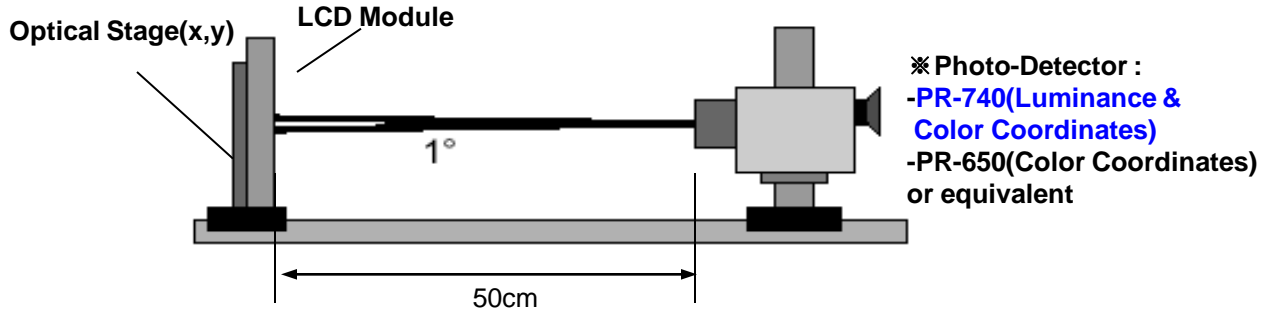
Parameter	Value			Unit	Notes
	Min	Typ	Max		
T1	0.5	-	10	ms	
T2	30	-	-	ms	
T3	100	-	-	ms	1
T4	250	-	-	ms	
T5	33.4	-	-	ms	
T6	0	-	50	ms	
T7	500	-	-	ms	

- Note 1. While TCON operates in master mode(T3), it is not allowed to communicate I2C from serializer.
 2. Please avoid floating state of all input signals.
 3. When the LVDS signal is invalid, be sure to pull down the power supply for LCD to 0V.
 4. When Power On Sequence or during operation, interface signal is not allowed momentary off or abnormal waveform.

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6. Electro-optical Characteristics

Electro-optical characteristics are determined after the unit has been 'ON' and stable in a dark environment at $25 \pm 2^\circ\text{C}$. The values are specified at an approximate distance 50cm from the LCD surface at a viewing angle of and equal to 0° . Measured value at the center point of LCD panel after more than 20 minutes while backlight turning on.

It is presented additional information concerning the measurement equipment and method in FIG. 2.


FIG. 2 Electro-optical Characteristic Measurement Equipment and Method
Table 8. ELECTRO-OPTICAL CHARACTERISTICS

*Ta=25±2°C, VLCD=12V, fv=60Hz, fdCLK=Typ

Parameter		Symbol	Value			Unit	Notes
			Min	Typ	Max		
Contrast Ratio	$\Theta=0^\circ$	CR	1200:1	1450:1	-		1, 3, 7
Luminance	$\Theta=0^\circ$	L	640	800	-	cd/m ²	2, 7
Luminance Uniformity		LU _w 9P	80	-	-	%	3
Response Time [25°C]	Rise Time	Tr _R	-	10	17	ms	4
	Decay Time	Tr _D	-	8	13	ms	
Response Time [-30°C]	Rise Time	Tr _R	-	175	200	ms	
	Decay Time	Tr _D	-	125	150	ms	
Color Coordinates [CIE1931]	RED	Rx	Typ -0.025	0.674	Typ +0.025		7
		Ry		0.313			
	GREEN	Gx		0.270			
		Gy		0.644			
	BLUE	Bx		0.149			
		By		0.058			
	WHITE	Wx		0.313			
		Wy		0.329			
Viewing Angle (CR>10)	x axis, right($\phi=0^\circ$)	θ_r	89	-	-	degree	5
	x axis, left ($\phi=180^\circ$)	θ_l	89	-	-		
	y axis, up ($\phi=90^\circ$)	θ_u	89	-	-		
	y axis, down ($\phi=270^\circ$)	θ_d	89	-	-		
Viewing Angle (CR>100)	x axis, right($\phi=0^\circ$)	θ_r	60	-	-	degree	
	x axis, left ($\phi=180^\circ$)	θ_l	60	-	-		
	y axis, up ($\phi=90^\circ$)	θ_u	60	-	-		
	y axis, down ($\phi=270^\circ$)	θ_d	60	-	-		
Gamma			2.1	2.2	2.3		6, 7

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

$$\text{Contrast Ratio} = \frac{\text{Surface Luminance with all white pixels}}{\text{Surface Luminance with all black pixels}}$$

It is measured at center 1-point.

2. Surface luminance are determined after the unit has been 'ON' and More than 20 Minute after lighting the backlight in a dark environment at $25 \pm 2^\circ\text{C}$. 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. 3.

When using PR-880 or PR680 as a measuring device, follow the luminance spec. below.

Parameter	Symbol	Value			Unit	
		Min	Typ	Max		
Luminance (PR880/PR680)	$\Theta=0^\circ$	L	600	750	-	cd/m ²

3. The luminance uniformity (LNU_W) is determined by measuring luminance at each test position 1 through 9.

The Luminance Uniformity (LU_W) is defined as follows ;

$$\text{Luminance Uniformity (} LU_W \text{)} = \left(\frac{\text{Minimum}(L1, L2, L3, L4, L5, L6, L7, L8, L9)}{\text{Maximum}(L1, L2, L3, L4, L5, L6, L7, L8, L9)} \right) \times 100 (\%)$$

For more information see the FIG. 3.

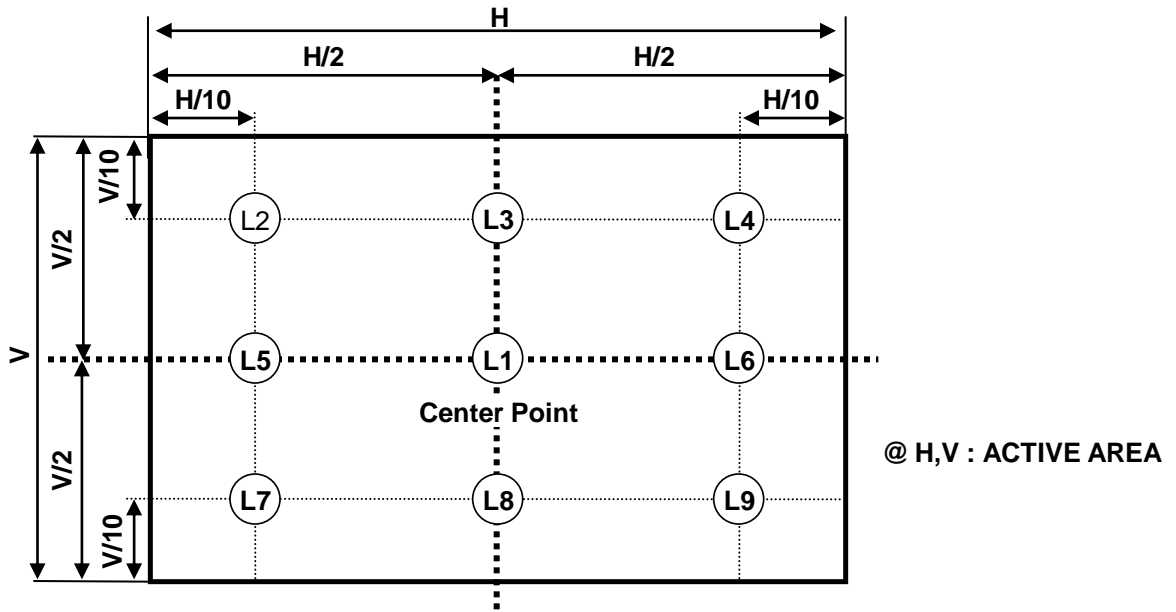


FIG. 3 9 Points for Luminance Measure

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Note 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. 4. Low temperature(-30°C) response time is reference value.

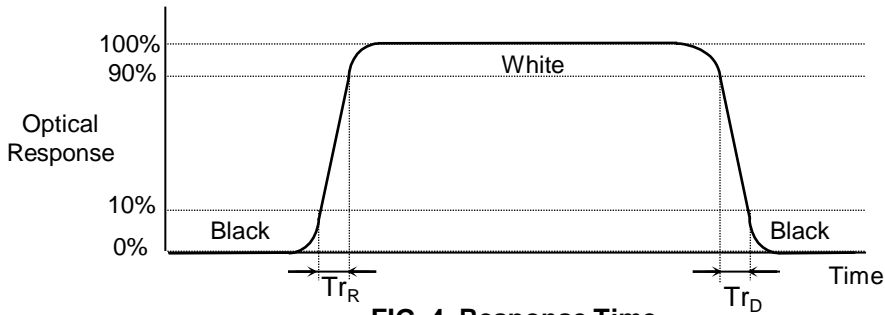


FIG. 4 Response Time

5. 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. 5.

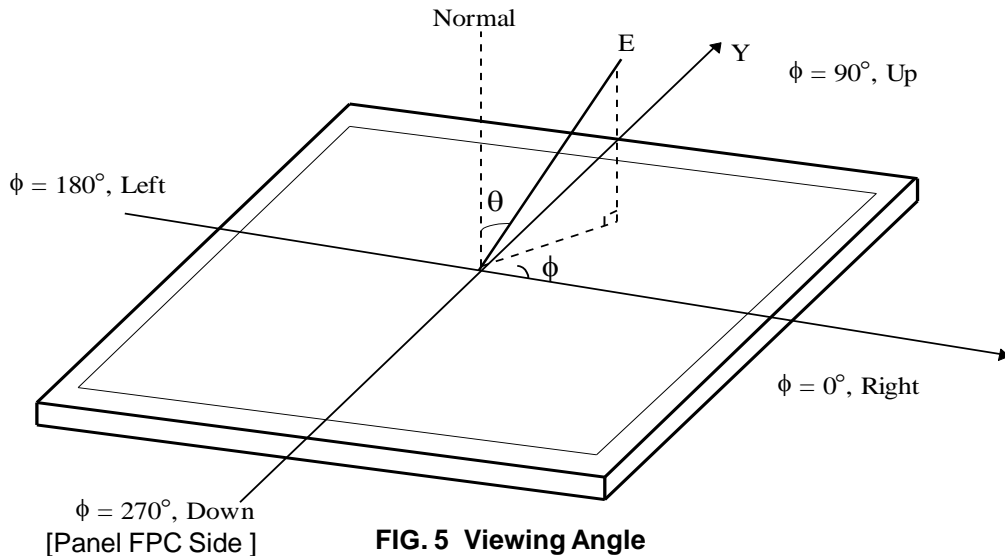


FIG. 5 Viewing Angle

6. Gamma specification

Measurement and evaluation to be performed according Information Displays Measurement Standard(IDMS) Version 1.03 (2012-Jun-01) section 6.3. (9 point LOG-LOG Gamma)

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7. Mechanical Characteristics

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

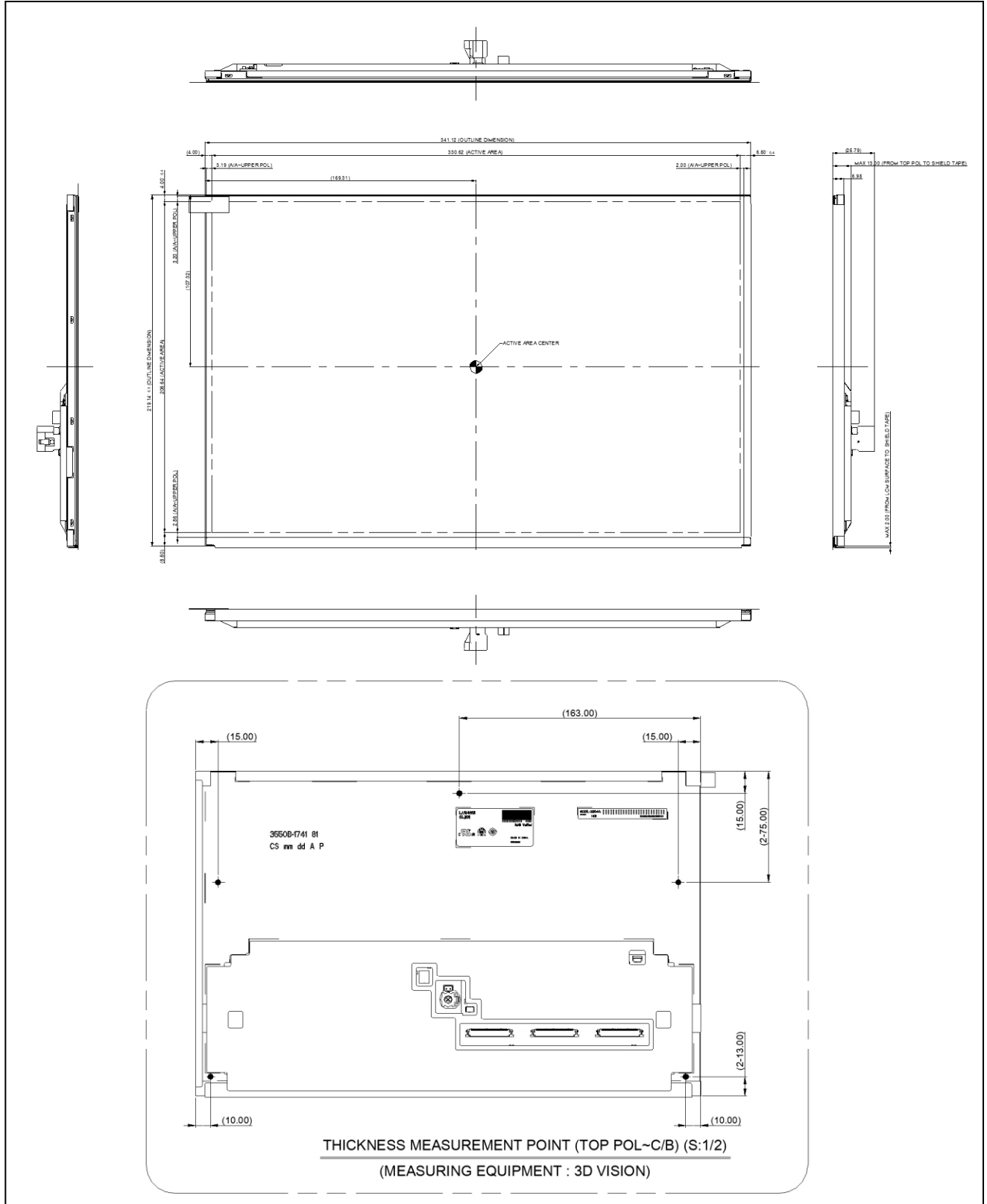
Table 9. MECHANICAL CHARACTERISTICS

Parameter	Value	
Outline Dimension	Horizontal	341.12 ± 0.3 mm
	Vertical	219.14 ± 0.3 mm
	Depth	6.95 ± 0.3 mm
Bezel Area	Horizontal (Left / Right)	(4.0) / 6.50 ± 0.4 mm
	Vertical (Up / Down)	4.0 ± 0.4 / (8.50) mm
Active Display Area	Horizontal	330.62 mm
	Vertical	206.64 mm
Weight	830g(Typ.), 850g(Max.)	

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<FRONT VIEW>

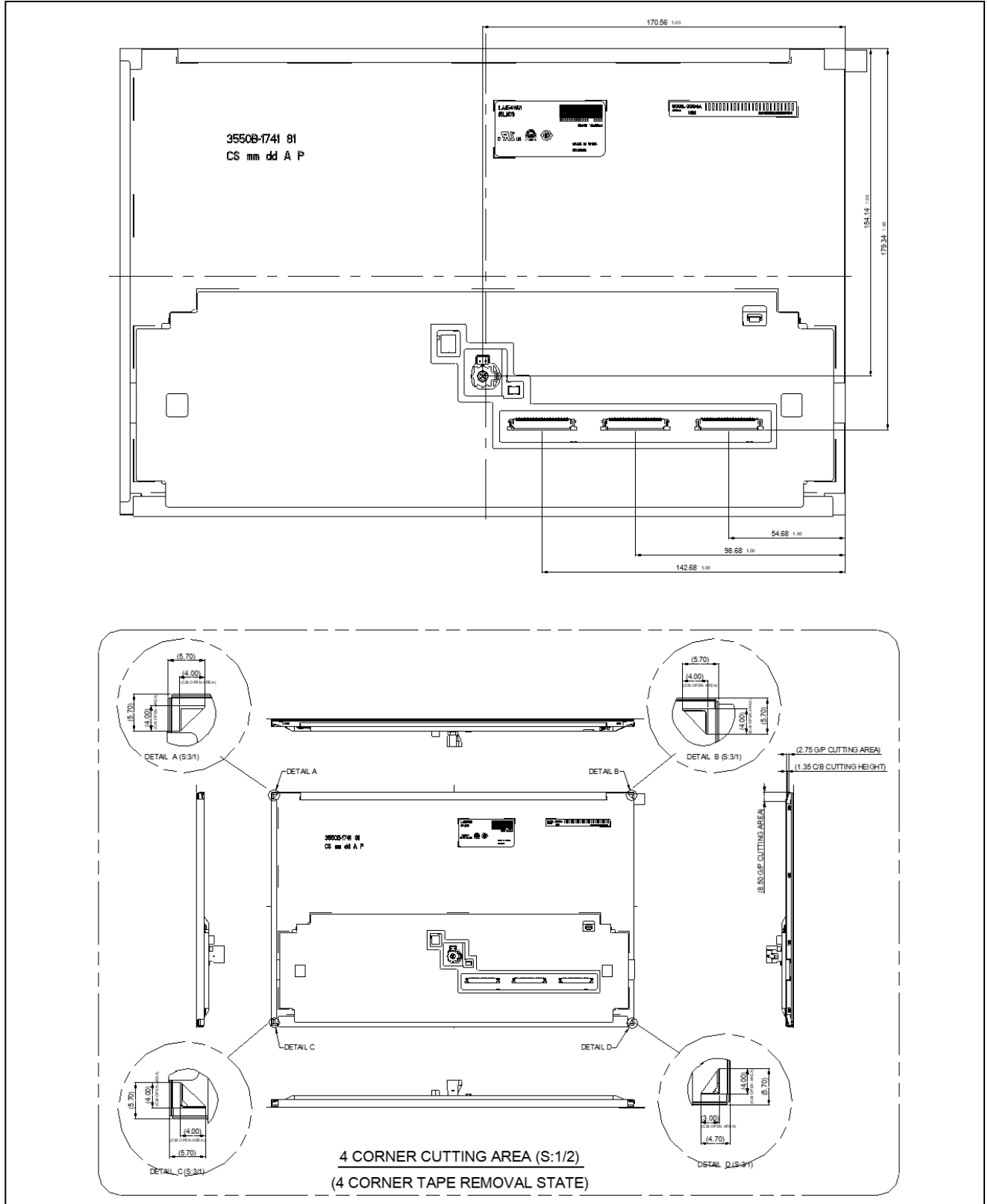
Note. Unit:[mm], General tolerance: ± 0.3mm



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<REAR VIEW>

Note. Unit:[mm], General tolerance: ± 0.3mm



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8. Reliability
Table 10. ENVIRONMENT TEST CONDITION

No.	Test Item	Condition	Notes																																
1	High/Low Temperature Storage shipping	T _a = -40 °C 12h, T _a = 95 °C 12h (Vibration, Non-Operation)	1																																
2-a	Thermal Shock	T _a = -40 °C (0.5h) ↔ 95 °C (0.5h), 150 Cycles (Non-Operation)	1,2,3,4																																
2-b	Power Thermal Cycle	T _a = -30 °C (0.5h) ↔ 85 °C (0.5h), 600 Cycles (Operation)																																	
3-a	Low Temperature Cycle	T _a = -30 °C, 120h (10min ON / 50min OFF)	1,2,3,4																																
3-b	High Temperature Operation	T _a = 85 °C, 1000h (Operation)																																	
4	High Temperature High Humidity Storage	T _a = 85 °C / 85%RH, 1000h (Non-Operation)	5																																
5	High Temperature High Humidity Operation	T _a = 65 °C / 90%RH, 1000h (Operation)	1,3,4																																
6	Solar Radiation	Black Panel Temperature = 80 °C, 0.33W/m ² @340nm 384h	1,3,4																																
7	Vibration With Thermal Cycling Operation	Duration : 23hrs per axis Operation <table border="1" style="margin-left: 20px;"> <thead> <tr> <th>Axis</th> <th>X</th> <th>Y</th> <th>Z</th> </tr> </thead> <tbody> <tr> <td>Grms</td> <td>0.47</td> <td>0.57</td> <td>1.02</td> </tr> <tr> <td>Frequency (Hz)</td> <td>(G²/Hz)</td> <td>(G²/Hz)</td> <td>(G²/Hz)</td> </tr> <tr> <td>5</td> <td>0.0055</td> <td>0.0125</td> <td>0.05</td> </tr> <tr> <td>16</td> <td>0.008</td> <td>0.0075</td> <td>0.06</td> </tr> <tr> <td>42</td> <td>0.0018</td> <td>0.0034</td> <td>0.007</td> </tr> <tr> <td>160</td> <td>0.00007</td> <td>0.0003</td> <td>0.0005</td> </tr> <tr> <td>200</td> <td>0.00002</td> <td>0.0001</td> <td>0.0002</td> </tr> </tbody> </table> 1. 1h : Ramp up Temperature (R.T → 85 °C) 2. 10h : Dwell (85 °C) 3. 2h : Ramp Down Temperature (85 °C → -40 °C) 4. 10h : Dwell (-40 °C)	Axis	X	Y	Z	Grms	0.47	0.57	1.02	Frequency (Hz)	(G ² /Hz)	(G ² /Hz)	(G ² /Hz)	5	0.0055	0.0125	0.05	16	0.008	0.0075	0.06	42	0.0018	0.0034	0.007	160	0.00007	0.0003	0.0005	200	0.00002	0.0001	0.0002	
Axis	X	Y	Z																																
Grms	0.47	0.57	1.02																																
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160	0.00007	0.0003	0.0005																																
200	0.00002	0.0001	0.0002																																
8	Mechanical Shock Pothole Operation	1 direction (Car Orientation), 15ms, Half sine 25G 400 Shocks																																	
9	Mechanical Shock Collision Operation	1 direction for 1 unit (6 directions for 6 units) 11ms, Half sine 50G 10 Shocks																																	
10	Electro Static Discharge	1. Panel Surface 330Ω, 150pF, ±15kV, 25times (Air, Operation) 2. Cover bottom 330Ω, 150pF, ±15kV, 5times (Contact, Non-operation)	6,7																																

Product Specification

No.	Test Item	Condition	Notes
11	Image Sticking	25 °C Pattern for burn-in : Chess(8x6) Pattern x 6hrs Pattern for Evaluation : 63 Gray	8

Note. 1. Result Evaluation Criteria:

- TFT-LCD panels should take place at room temperature for 24 hours after the reliability tests finish.
- In the standard condition, there should be no particular problems that may affect the display function.
- 2. Test 'a' and 'b' are sequential test. (first 'a')
- 3. Polarizer defect can be occurred out of polarizer guarantee specification.
- 4. Optical sheets wrinkle judgment standard is an angle of 45 degrees.
- 5. For reference test.
- 6. Front of panel surface (Panel edge is not included for testing. Not guaranteed area)
- 7. ESD Criteria:
 - 1) Panel surface : Level C
 - 2) Cover bottom : Level A

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

8. Image Sticking Evaluation Criteria:

Level 2.5 with naked eye at 63 gray pattern right after 6 hours operation at room temperature.

Product Specification**9. International Standards****9-1. Safety**

- a) UL 60950-1, Underwriters Laboratories Inc.
Information Technology Equipment - Safety - Part 1 : General Requirements.
- b) CAN/CSA-C22.2 No. 60950-1-07, Canadian Standards Association.
Information Technology Equipment - Safety - Part 1 : General Requirements.
- c) EN 60950-1, European Committee for Electrotechnical Standardization (CENELEC).
Information Technology Equipment - Safety - Part 1 : General Requirements.
- d) 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 Industrie Normen
Determination of burning behaviour of interior materials in motor vehicles.
 - FMVSS 302, Federal Motor Vehicle Safety Standards
Flammability of Interior Materials

9-2. Environment

- a) RoHS, Directive 2002/95/EC of the European Parliament and of the council of 27 January 2003

Product Specification

10. Packing

10-1. Designation of Lot Mark



Note1. E200909 : Manufacturer(LG Display)

a) Lot Mark



A,B,C : SIZE(INCH)
E : MONTH

D : YEAR
F ~ M : SERIAL NO.

Note

1. YEAR

Year	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020
Mark	A	B	C	D	E	F	G	H	J	K

2. MONTH

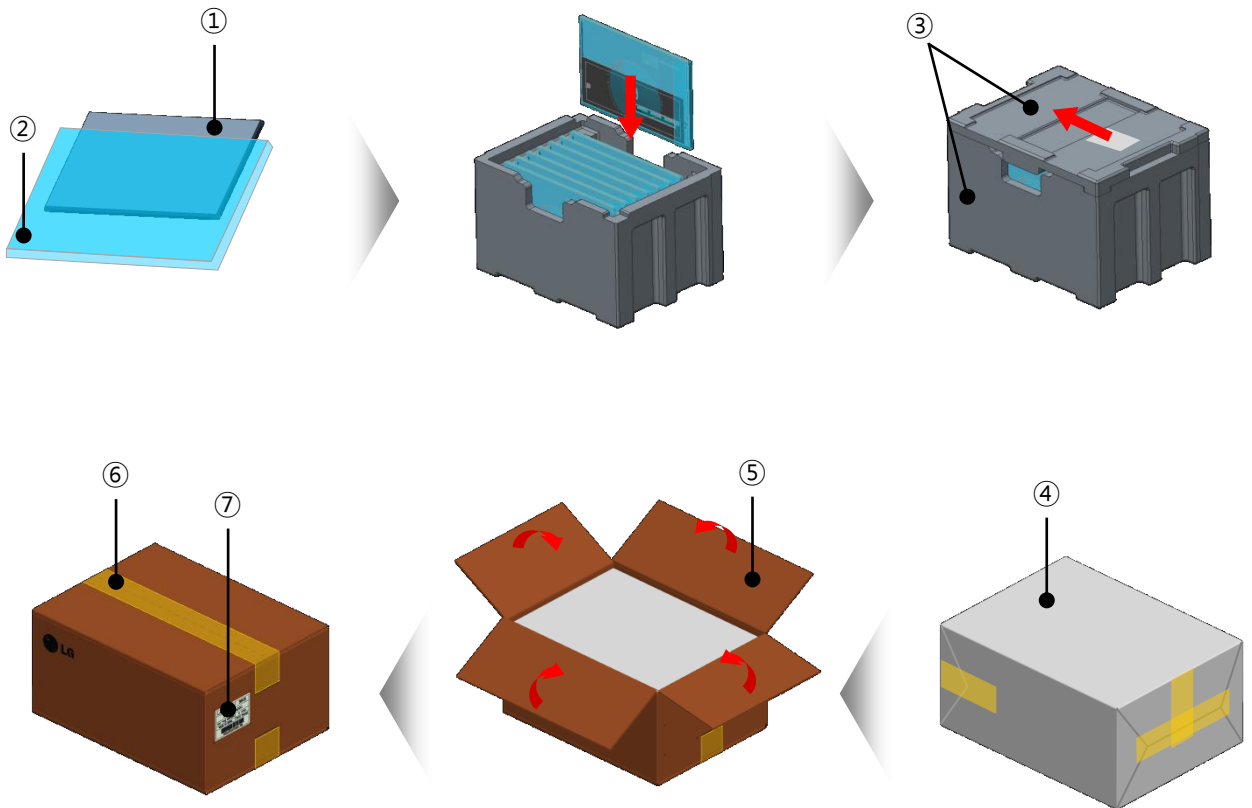
Month	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Mark	1	2	3	4	5	6	7	8	9	A	B	C

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.

Product Specification
10-2. Packing Form

- a) Package quantity in one box : 8 pcs
- b) Box Size : 478 mm × 365 mm × 328 mm



NO.	Description	Material
1	Module	8pcs/1 Box
2	Bag	LDPE
3	Packing	EPP
4	AL Bag	AL
5	Box	Corrugate board
6	Tape	OPP
7	Box Label	ART Paper

Product Specification

11. PRECAUTIONS

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

11-1. MOUNTING PRECAUTIONS

- (1) You must mount a module using specified mounting structure.(Details refer to the drawings)
- (2) You should consider the mounting structure so that uneven force(ex. Twisted stress) is not applied to the module.
And the case on which a module is mounted should have sufficient strength so that external force is not transmitted directly to the module.
- (3) 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.
- (4) You should adopt radiation structure to satisfy the temperature specification.
- (5) Acetic acid type and chlorine type materials for the cover case are not desirable because the former generates corrosive gas of attacking the polarizer at high temperature and the latter causes circuit break by electro-chemical reaction.
- (6) 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 with chemical treatment.
Do not touch the surface of polarizer for bare hand or greasy cloth.(Some cosmetics deteriorate the polarizer.)
- (7) When the surface becomes dusty, please wipe gently with absorbent cotton or other soft materials like chamois soaks with petroleum benzine. 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.
- (8) Wipe off saliva or water drops as soon as possible. Their long time contact with polarizer causes deformations and color fading.
- (9) Do not open the case because inside circuits do not have sufficient strength.
- (10) The metal case of a module should be contacted to electrical ground of your system.

11-2. OPERATING PRECAUTIONS

- (1) The spike noise causes the mis-operation of circuits. It should be lower than following voltage :
 $V = \pm 200\text{mV}$ (Over and under shoot voltage)
- (2) Response time depends on the temperature.(In lower temperature, it becomes longer.)
- (3) Brightness depends on the temperature. (In higher temperature, it becomes lower.)
- (4) Be careful for condensation at sudden temperature change. Condensation makes damage to polarizer or electrical contacted parts. And after fading condensation, smear or spot will occur.
- (5) When fixed patterns are displayed for a long time, remnant image is likely to occur.
- (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.

Product Specification**11-3. ELECTROSTATIC DISCHARGE CONTROL**

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

11-4. PRECAUTIONS FOR STRONG LIGHT EXPOSURE

Strong light exposure causes degradation of polarizer and color filter.

11-5. STORAGE

When storing modules as spares for a long time, the following precautions are necessary.

- (1) Store them in a dark place. Do not expose the module 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.

11-6. 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 such a condition, etc.
- (2) When the module 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) You can remove the glue easily. 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.

Product Specification
APPENDIX-I
■ Temp Sensor Characteristics

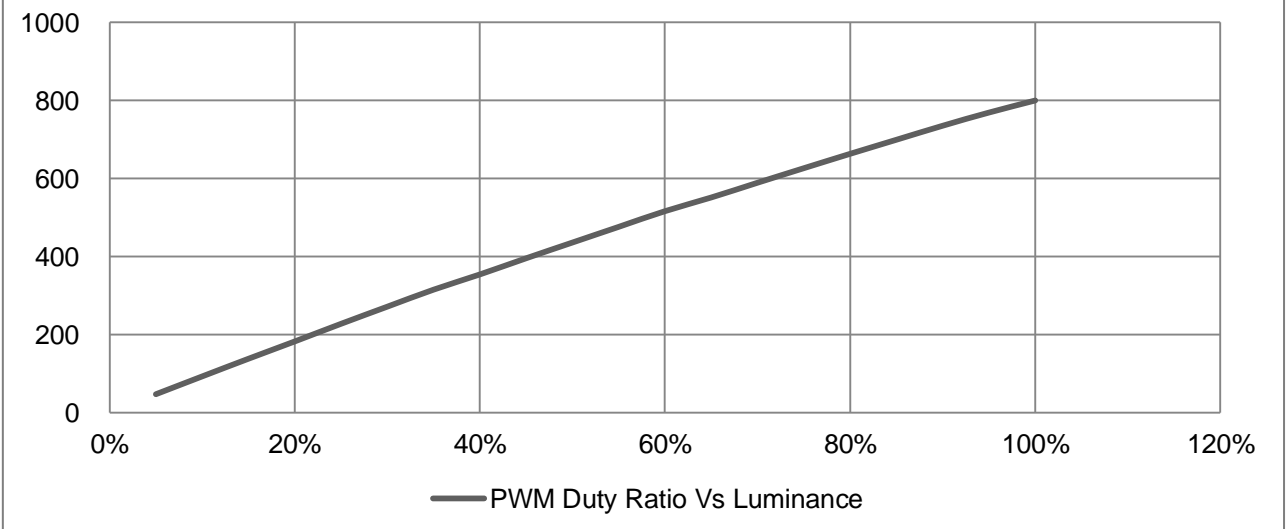
Note 1. Temp Sensor type is TMP75B-Q1

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

$^{\circ}\text{C}(\text{Ta})$	$T_{\text{temp}} \text{ Sensor } [^{\circ}\text{C}] \text{ (LCM)}$
-30	-18.19
-25	-15.50
-20	-10.38
-15	-5.94
-10	-0.69
-5	4.06
0	8.69
5	13.50
10	18.44
15	23.44
20	27.81
25	32.69
30	37.56
35	47.50
40	52.44
45	57.69
50	61.69
55	66.38
60	70.88
65	75.63
70	80.38
75	85.31
80	91.94
85	97.13

Product Specification
APPENDIX-II
■ Relation between PWM dimming ratio and luminance

PWM Duty Ratio	Luminance(Ref.)	Luminance Ratio
100%	800 nit	100.0%
95%	769 nit	96.1%
90%	735 nit	91.9%
85%	699 nit	87.4%
80%	663 nit	82.9%
75%	626 nit	78.3%
70%	589 nit	73.6%
65%	551 nit	68.9%
60%	516 nit	64.5%
55%	476 nit	59.5%
50%	436 nit	54.5%
45%	395 nit	49.4%
40%	354 nit	44.2%
35%	315 nit	39.4%
30%	271 nit	33.9%
25%	227 nit	28.4%
20%	182 nit	22.8%
15%	138 nit	17.2%
10%	92 nit	11.5%
5%	47 nit	5.8%

PWM Duty Ratio Vs Luminance


Product Specification
APPENDIX-III (1/4)
■ Enhanced Extended Display Identification Data (EEDID 1.4)

- Device Address: 0xA0 (@8bit) / 0x50 (@7bit)

	Byte (Dec)	Byte (Hex)	Field Name and Comments	Value (Hex)	Value (Bin)
Header	0	00	Header	00	00000000
	1	01	Header	FF	11111111
	2	02	Header	FF	11111111
	3	03	Header	FF	11111111
	4	04	Header	FF	11111111
	5	05	Header	FF	11111111
	6	06	Header	FF	11111111
Vendor / Product EDID Version	7	07	Header	00	00000000
	8	08	ID Manufacture Name LGD	30	00110000
	9	09	ID Manufacture Name	E4	11100100
	10	0A	ID Product Code 0000h	00	00000000
	11	0B	(Hex. LSB first)	00	00000000
	12	0C	ID Serial No. - Optional ("00h" If not used, Number Only and LSB First)	00	00000000
	13	0D	ID Serial No. - Optional ("00h" If not used, Number Only and LSB First)	00	00000000
	14	0E	ID Serial No. - Optional ("00h" If not used, Number Only and LSB First)	00	00000000
	15	0F	ID Serial No. - Optional ("00h" If not used, Number Only and LSB First)	00	00000000
	16	10	Week of Manufacture - Optinal 00 weeks	00	00000000
	17	11	Year of Manufacture 2016 years	1A	00011010
	18	12	EDID structure version # = 1	01	00000001
19	13	EDID revision # = 4	04	00000100	
Display Parameters	20	14	Video input Definition = Input is a Digital Video signal Interface , Colo Bit Depth : 8 Bits per Primary Color , Digital Video Interface Standard Supported: DisplayPort is supported	A5	10100101
	21	15	Horizontal Screen Size (Rounded cm) = 33 cm	21	00100001
	22	16	Vertical Screen Size (Rounded cm) = 21 cm	15	00010101
	23	17	Display Transfer Characteristic (Gamma) = (gamma*100)-100 = Example:(2.2*100)-100=120	78	01111000
Panel Color Coordinates	24	18	Feature Support [Display Power Management(DPM) : Standby Mode is not supported, Suspend Mode is not supported, Active Off = Very Low Power is not supported ,Supported Color Encoding Formats : RGB 4:4:4 ,Other Feature Support Flags : No_sRGB, Preferred Timing Mode, No_Display is continuous frequency (Multi-mode_Base EDID and Extension Block).]	02	00000010
	25	19	Red/Green Low Bits (RxRy/GxGy)	93	10010011
	26	1A	Blue/White Low Bits (BxBy/WxWy)	75	01110101
	27	1B	Red X Rx = 0.674	AC	10101100
	28	1C	Red Y Ry = 0.313	50	01010000
	29	1D	Green X Gx = 0.270	45	01000101
	30	1E	Green Y Gy = 0.644	A4	10100100
	31	1F	Blue X Bx = 0.149	26	00100110
	32	20	Blue Y By = 0.058	0E	00001110
	33	21	White X Wx = 0.313	50	01010000
34	22	White Y Wy = 0.329	54	01010100	
Established Timings	35	23	Established timing 1 (Optional_00h if not used)	00	00000000
	36	24	Established timing 2 (Optional_00h if not used)	00	00000000
	37	25	Manufacturer's timings (Optional_00h if not used)	00	00000000
Standard Timing ID	38	26	Standard timing ID1 (Optional_01h if not used)	01	00000001
	39	27	Standard timing ID1 (Optional_01h if not used)	01	00000001
	40	28	Standard timing ID2 (Optional_01h if not used)	01	00000001
	41	29	Standard timing ID2 (Optional_01h if not used)	01	00000001
	42	2A	Standard timing ID3 (Optional_01h if not used)	01	00000001
	43	2B	Standard timing ID3 (Optional_01h if not used)	01	00000001
	44	2C	Standard timing ID4 (Optional_01h if not used)	01	00000001
	45	2D	Standard timing ID4 (Optional_01h if not used)	01	00000001
	46	2E	Standard timing ID5 (Optional_01h if not used)	01	00000001
	47	2F	Standard timing ID5 (Optional_01h if not used)	01	00000001
	48	30	Standard timing ID6 (Optional_01h if not used)	01	00000001
	49	31	Standard timing ID6 (Optional_01h if not used)	01	00000001
	50	32	Standard timing ID7 (Optional_01h if not used)	01	00000001
	51	33	Standard timing ID7 (Optional_01h if not used)	01	00000001
	52	34	Standard timing ID8 (Optional_01h if not used)	01	00000001
	53	35	Standard timing ID8 (Optional_01h if not used)	01	00000001

Product Specification
APPENDIX-III (2/4)
■ Enhanced Extended Display Identification Data (EEDID 1.4)

- Device Address: 0xA0 (@8bit) / 0x50 (@7bit)

Timing Descriptor #1	54	36	Pixel Clock/10,000 (LSB)	154 MHz @ 60 Hz	28	00101000
	55	37	Pixel Clock/10,000 (MSB)		3C	00111100
	56	38	Horizontal Active (HA) (lower 8 bits)	1920 pixels	80	10000000
	57	39	Horizontal Blanking (HB) (lower 8 bits)	160 pixels	A0	10100000
	58	3A	Horizontal Active (HA) / Horizontal Blanking (HB) (upper 4:4bits)		70	01110000
	59	3B	Vertical Active (VA)	1200 lines	B0	10110000
	60	3C	Vertical Blanking (VB) (DE Blanking typ. for DE only panels)	35 lines	23	00100011
	61	3D	Vertical Active (VA) / Vertical Blanking (VB) (upper 4:4bits)		40	01000000
	62	3E	Horizontal Front Porch in pixels (HF) (lower 8 bits)	48 pixels	30	00110000
	63	3F	Horizontal Sync Pulse Width in pixels (HS) (lower 8 bits)	32 pixels	20	00100000
	64	40	Vertical Front Porch in lines (VF) : Vertical Sync Pulse Width in lines (VS) (lower 4 bits)	3 lines : 6 lines	36	00110110
	65	41	Horizontal Front Porch/ Sync Pulse Width/ Vertical Front Porch/ Sync Pulse Width (upper 2bits)		00	00000000
	66	42	Horizontal Video Image Size (mm) (lower 8 bits)	331 mm	4B	01001011
	67	43	Vertical Video Image Size (mm) (lower 8 bits)	207 mm	CF	11001111
	68	44	Horizontal Image Size / Vertical Image Size (upper 4 bits)		10	00010000
	69	45	Horizontal Border = 0 (Zero for Notebook LCD)		00	00000000
	70	46	Vertical Border = 0 (Zero for Notebook LCD)		00	00000000
71	47	Non-Interlace, Normal display, no stereo, Digital Separate [Vsync_NEG, Hsync_NEG (outside of V-sync)]		19	00011001	
Timing Descriptor #2	72	48	Flag		00	00000000
	73	49	Flag		00	00000000
	74	4A	Flag		00	00000000
	75	4B	Data Type Tag (Descriptor Defined by manufacturer)		00	00000000
	76	4C	Flag		00	00000000
	77	4D	Descriptor Defined by manufacturer		00	00000000
	78	4E	Descriptor Defined by manufacturer		00	00000000
	79	4F	Descriptor Defined by manufacturer		00	00000000
	80	50	Descriptor Defined by manufacturer		00	00000000
	81	51	Descriptor Defined by manufacturer		00	00000000
	82	52	Descriptor Defined by manufacturer		00	00000000
	83	53	Descriptor Defined by manufacturer		00	00000000
	84	54	Descriptor Defined by manufacturer		00	00000000
	85	55	Descriptor Defined by manufacturer		00	00000000
	86	56	Descriptor Defined by manufacturer		00	00000000
	87	57	Descriptor Defined by manufacturer		00	00000000
	88	58	Descriptor Defined by manufacturer		00	00000000
	89	59	Descriptor Defined by manufacturer		00	00000000
	Timing Descriptor #3	90	5A	Flag		00
91		5B	Flag		00	00000000
92		5C	Flag		00	00000000
93		5D	Data Type Tag (Alphanumeric Data String (ASCII String))		FE	11111110
94		5E	Flag		00	00000000
95		5F	Alphanumeric Data String (ASCII String)	L	4C	01001100
96		60	Alphanumeric Data String (ASCII String)	G	47	01000111
97		61	Alphanumeric Data String (ASCII String)		20	00100000
98		62	Alphanumeric Data String (ASCII String)	D	44	01000100
99		63	Alphanumeric Data String (ASCII String)	i	69	01101001
100		64	Alphanumeric Data String (ASCII String)	s	73	01110011
101		65	Alphanumeric Data String (ASCII String)	p	70	01110000
102		66	Alphanumeric Data String (ASCII String)	l	6C	01101100
103		67	Alphanumeric Data String (ASCII String)	a	61	01100001
104		68	Alphanumeric Data String (ASCII String)	y	79	01111001
105		69	Manufacturer P/N (If <13 char -> 0Ah, then terminate with ASC II code 0Ah, set remaining char = 20h)		0A	00001010
106		6A	Manufacturer P/N (If <13 char -> 0Ah, then terminate with ASC II code 0Ah, set remaining char = 20h)		20	00100000
107		6B	Manufacturer P/N (If <13 char -> 0Ah, then terminate with ASC II code 0Ah, set remaining char = 20h)		20	00100000

Product Specification
APPENDIX-III (3/4)
■ Enhanced Extended Display Identification Data (EEDID 1.4)

- Device Address: 0xA0(@8bit) / 0x50(@7bit)

	Byte (Dec)	Byte (Hex)	Field Name and Comments	Value (Hex)	Value (Bin)
Timing Descriptor #4	108	6C	Flag	00	00000000
	109	6D	Flag	00	00000000
	110	6E	Flag	00	00000000
	111	6F	Data Type Tag (Alphanumeric Data String (ASCII String))	FE	11111110
	112	70	Flag	00	00000000
	113	71	Alphanumeric Data String (ASCII String) L	4C	01001100
	114	72	Alphanumeric Data String (ASCII String) A	41	01000001
	115	73	Alphanumeric Data String (ASCII String) 1	31	00110001
	116	74	Alphanumeric Data String (ASCII String) 5	35	00110101
	117	75	Alphanumeric Data String (ASCII String) 4	34	00110100
	118	76	Alphanumeric Data String (ASCII String) W	57	01010111
	119	77	Alphanumeric Data String (ASCII String) U	55	01010101
	120	78	Alphanumeric Data String (ASCII String) 1	31	00110001
	121	79	Alphanumeric Data String (ASCII String) -	2D	00101101
	122	7A	Alphanumeric Data String (ASCII String) S	53	01010011
123	7B	Alphanumeric Data String (ASCII String) L	4C	01001100	
124	7C	Alphanumeric Data String (ASCII String) 0	30	00110000	
125	7D	Alphanumeric Data String (ASCII String) 1	31	00110001	
Checksum	126	7E	Extension flag (# of optional 128 panel ID extension block to follow, Typ = 0)	00	00000000
	127	7F	Check Sum(The 1-byte sum of all 128 bytes in this panel ID block shall = 0)	D9	11011001

Product Specification
APPENDIX-III (4/4)
■ Optical Data information

- Device Address: 0xA0(@8bit) / 0x50(@7bit)

	Byte (Dec)	Byte (Hex)	Field Name and Comments		Value (Hex)	Value (Bin)
<i>Optical Data</i>	256	100h	LGD Writing	Red x	-	-
	257	101h		Red y	-	-
	258	102h		Green x	-	-
	259	103h		Green y	-	-
	260	104h		Blue x	-	-
	261	105h		Blue y	-	-
	262	106h		White x	-	-
	263	107h		White y	-	-
	264	108h		Gamma	-	-
	265	109h		Resevered	-	-
	266	10Ah		White Luminance	-	-
	267	10Bh			-	-
	268	10Ch			-	-
	269	10Dh			-	-
	270	10Eh			-	-
	271	10Fh			-	-
	272	110h			-	-
273	111h		-	-		
274	112h		-	-		
275	113h		-	-		

Product Specification
APPENDIX-IV
■ LVDS Format (Color Bit Mapping) : VESA
