

**Product Specification**

# SPECIFICATION FOR APPROVAL

- (    ) Preliminary Specification  
 ( ● ) Final Specification

<b>Title</b>	<b>14.5”FHD (2560 X RGB X 720) TFT- LCD</b>
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BUYER	
MODEL	
PROJECT	

SUPPLIER	LG Display Co., Ltd.
MODEL	LA145WF1
SUFFIX	SL02

SIGNATURE	SIGNITURE
/	_____
/	_____
/	_____

**Please return 1 copy for your confirmation  
With your signature and comments.**

APPROVED BY	SIGNITURE
_____	_____
<b>REVIEWED BY</b>	
_____	_____
_____	_____
<b>PREPARED BY</b>	
_____	_____

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

**Product Specification**
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**Record of Revisions**

Revision No.	Revision Date	Page	Description	Note
0.1	MAY. 14. 2021	-	Update : Brightness and Viewing Angle	

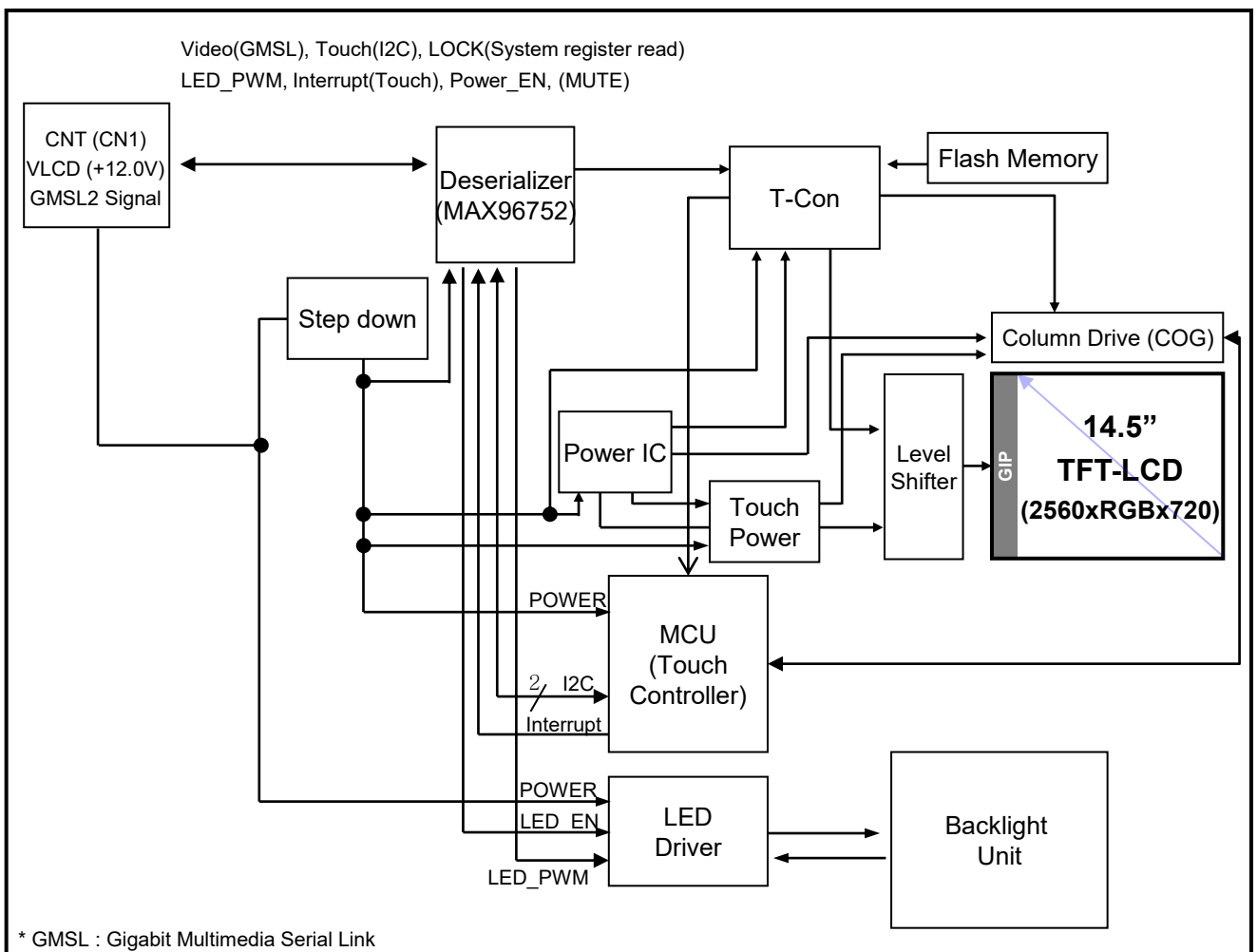
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### 1. Summary

This module utilizes amorphous silicon thin film transistors and a 32:9 aspect ratio. The 14.5" active matrix liquid crystal display allows 16,777,216 colors to be displayed by GMSL2 interface is available. The applications are Cluster, CID(Center Information Display) and Instrument Cluster for a vehicle.

### 2. Features

- Utilizes a panel with a 32:9 aspect ratio.
- The 14.5" screen produces a high resolution image that is composed of 1,843,200 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	14.5 inches diagonal	
Outline Dimension	361.82mm(H) x 112.4mm(V) x 12.8mm(D) (Typ.), (W/ PemNut, W/ Cover Glass 1.1T)	
Pixel Pitch	0.1386mm x 0.1386mm (1Dot: 0.0462mm x 0.1386mm)	
Pixel Format	2560 horiz. by 720 vert. Pixels, RGB stripe arrangement	
Color Depth	8bit(D), 16,777,216 colors	
Luminance, White	1,000cd/m <sup>2</sup> (Center 1point ,Typ.)	
Viewing Angle (CR>10)	89/89/89/89 (L/R/U/D)	
Weight	595g (Typ.), 605g (Max.)	
Display Mode	Transmissive mode, Normally Black	
Surface Treatment	Material	Anti-Glare, Anti-Reflection, Anti-Finger (w/ASF)
	Hardness	3H, 500g (ISO15184, w/ASF)
	Reflectance	Max 2% (SCI)
Optical Bonding Material	Silicon Resin	
Backlight Type	LED	

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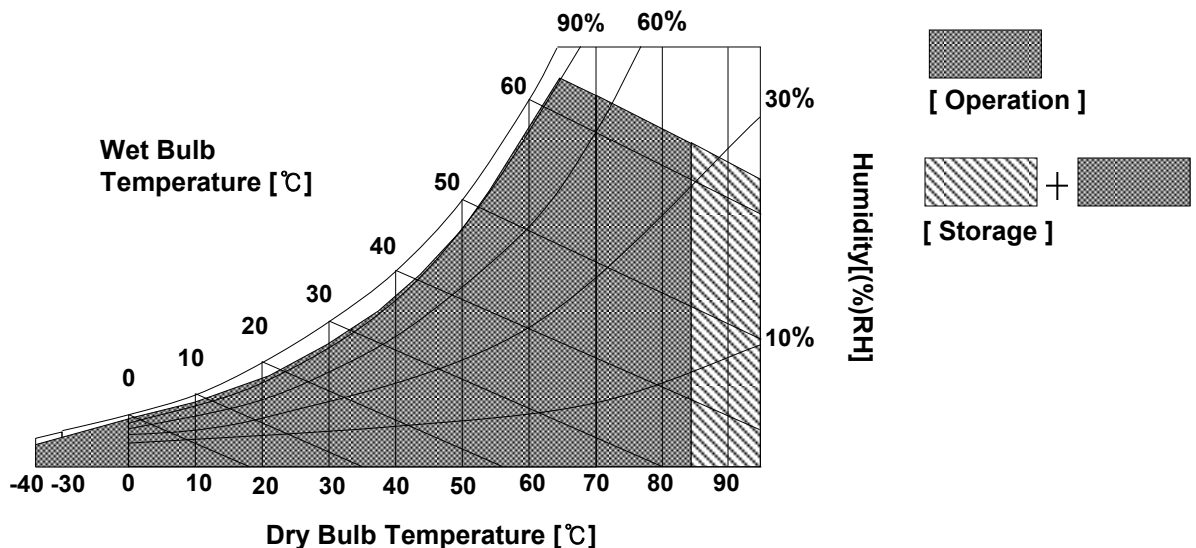
### 4. Absolute Maximum Ratings

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

**Table 4-1. ABSOLUTE MAXIMUM RATINGS**

Parameter		Symbol	Value		Unit	Note
			Min	Max		
Power Supply Voltage	LCD, Backlight	$V_{LCD}$	-0.3	36.0	V	1
Input Signal Voltage		$V_{GMSL}$	-0.3	1.9	V	2
Storage Temperature		$T_{ST}$	-40	95	°C	3
Operating Temperature		$T_{OP}$	-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.  $V_{GMSL2}$ : Single-Ended Inputs  
 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**

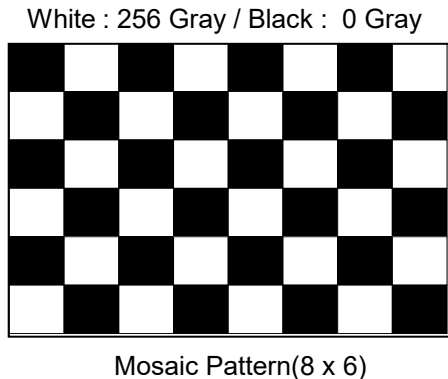
It requires one power inputs. One is employed to power for the LCD circuit and the LED backlight.

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

Parameter	Symbol	Value			Unit	Note	
		Min	Typ	Max			
Power Supply Voltage	V <sub>LCD</sub>	9.0	12.0	16.0	V	7,8	
Power Supply Current	Mosaic	I <sub>LCD</sub>	-	1.35	1.83	A	1
	White	I <sub>LCD</sub>	-	1.40	1.90	A	
Power Consumption	P <sub>LCD</sub>	-	16.8	22.8	W	1, 2	
Rush Current	I <sub>RUSH</sub>	-	-	5	A	3	
Input Signal (Data, Command)	V <sub>ISH</sub>	V <sub>CM</sub> + 0.05	-	-	V	4,5	
	V <sub>ISL</sub>	-	-	V <sub>CM</sub> - 0.05	V		
Output Signal (Reverse Command)	V <sub>ROSH</sub>	V <sub>CM</sub> + 0.05	-	-	V	4,6	
	V <sub>ROSL</sub>	-	-	V <sub>CM</sub> - 0.05	V		

- Note 1. The specified current and power consumption are under the V<sub>LCD</sub>=12.0V, Ta=25 ± 2°C, fv=60Hz condition whereas Mosaic pattern(8 x 6) and white pattern are displayed.
2. P<sub>LCD</sub>(Typ) = I<sub>LCD</sub>(Typ)\*V<sub>LCD</sub>(Typ), P<sub>LCD</sub>(Max) = I<sub>LCD</sub>(Max)\*V<sub>LCD</sub>(Typ)
3. The duration of rush current is about 2ms and rising time of power input is 0.5ms (min.). (V<sub>LCD</sub>=9.0V, Ta=25 ± 2°C, fv=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. LED\_EN, TSP\_RST, DSCH, HVR, LED\_PWM, LCD\_Test, I2C\_SCL, I2C\_SDA
6. Interrupt
7. If VLCD level dropped under 9V, then Backlight turn-off (LED\_EN) by System.
8. If VLCD level dropped under 6V, then VLCD must off by System.

\* V<sub>ISH</sub> : Input Single-Ended High Threshold Voltage / V<sub>ISL</sub> : Input Single-Ended Low Threshold Voltage  
 \* V<sub>ROSH</sub> : Reverse Output Single-Ended High Voltage / V<sub>ROSL</sub> : Reverse Output Single-Ended Low Voltage



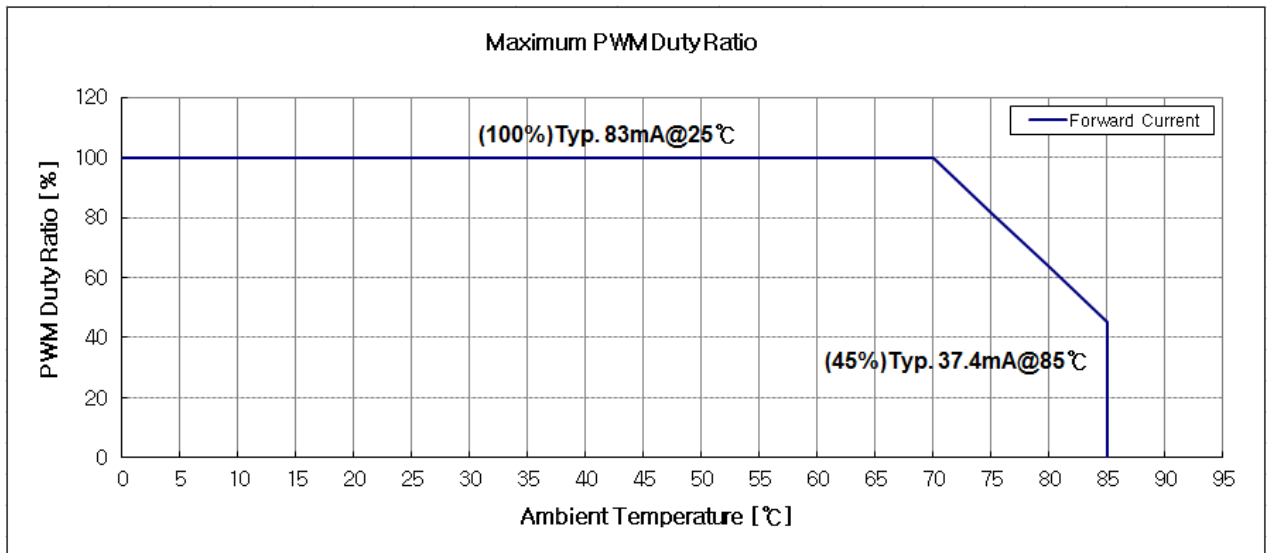
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**Table 5-1-2. BACKLIGHT ELECTRICAL CHARACTERISTICS**

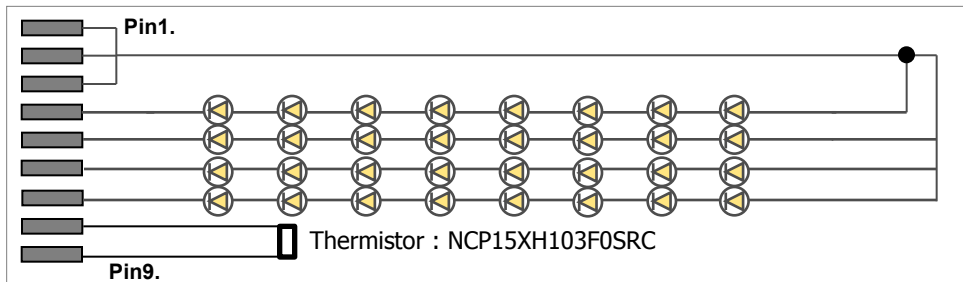
Parameter		Symbol	Values			Unit	Note
			Min	Typ	Max		
LED_PWM	Dimming Range	Dimming	10	-	100	%	On Duty Ratio
	Dimming Frequency	Fpwm	195	200	205	Hz	
Life Time	Intermittent	-	50,000	-	-	Hrs	2,3

- Note 1. The LED\_PWM is internally pulled down to Ground.  
 2. DC current dimming is recommended for LED control. If PWM dimming is needed, PWM frequency should be optimized for minimal wavy and audible noise.  
 3. The life time is determined as the time at which brightness of LED is 50% compare to that of initial value at the typical LED current.  
 4. DC current dimming is recommended for LED control. If PWM dimming is needed, PWM frequency should be optimized for minimal wavy and audible noise.

**LED Derating Curve**



**5. LED Chain**





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### 5-2. Interface Connections

This LCD employs a kind of interface connection, 5-pin Hybrid connector, that is used for LCD & backlight power supply and GMSL signals.

#### 5-2-1. Power Connector(CN1) Pin Configuration

The matching connector model name is MG646138-5(VRT, Black) manufactured by KET or equivalent.



Pin No	Name	I/O	Description	Note
1	VLCD	I	LCD Power Supply (+12V)	
2	NC	-	Not Connected (LGD internal Use for WP)	
3	NC	-	Not Connected	
4	GND	I	Ground	
5	GMSL2	I	Coaxial Signal	

#### 5-2-2. Deserializer GPIOs Pin Configuration

1. For Interfacing this device, it use GMSL signal with Deserializer MAX96752. That GPIOs Pin-map configured like below a table. All control signal's state is prescribed during LCD operating.

MAX96752 pin name		LCD Control PCB Pin Configuration			
Pin No.	Default	Pin Name	Description	Status	Note
8	SDA_RX	I2C_SDA	Touch I2C Data	Pulled-up	
9	SCL_TX	I2C_SCL	Touch I2C Clock	Pulled-up	
12	GPIO10	TSP_EN	Touch MCU reset	Pulled-up	H : Normal, L : Active(RESET)
24	SD/ADD0	ADD0	MUTE	Pulled-down	
25	SCK/ADD1	ADD1	ADD1	Pulled-down	
26	WS/ADD2	ADD2	HVR	NC	Low Only, High: Not available
27	SDIR	LED_EN	LED DIC Enable	Pulled-up	
28	SCKIR	LED_PWM	LED DIC Dimming	Pulled-down	LED PWM Dimming Control
29	WSIR	TSP_INT	Touch Interrupt	Pulled-up	H : Waiting, L : Touch Interrupt
40	GPIO03	UART_TX	UART_TX	NC	NC
41	GPIO04	Proximate interrupt	Proximate interrupt	Pulled-down	
42	GPIO05	UART_RX	UART_RX	NC	NC
45	GPIO02	LCD_TEST	LCD Testing point	Pulled-down	User don't use (NC)

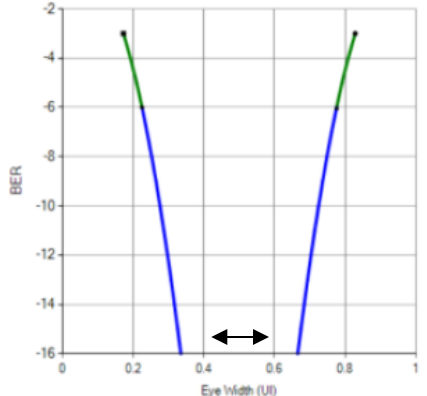
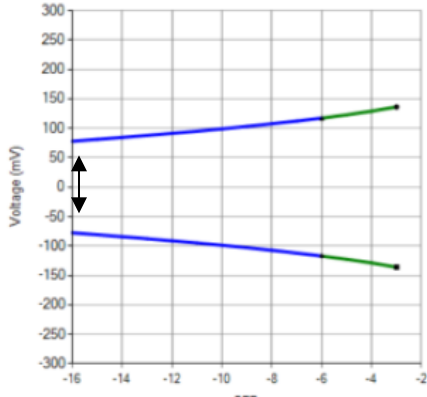
1. The TSP\_RST control LCD touch MCU reset.(Active 'Low')
2. The I2C\_SDA, I2C\_SCL use for touch interface by I2C protocol.
3. The LED\_EN control LCD internally generating Backlight enable pin.
4. The DSCH should be controlled as 5-6. Power Sequence to avoid Power on-off display flickering.
5. LCD\_TEST is used for LCD manufacturing. Customer should not connect.(NC)
6. Display Direction as following pictures, But This Model setting is Only Low  
Discussion with LGD is needed to change the scan direction.

HVR	Low	High
Display Image		

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**5-3. GMSL2 Link Characteristics**

The GMSL SerDes\* Link Performance need to meet below BER\* Bathtub Curve Values.

Channel	Minimum Eye Opening at BER = 10 <sup>-16</sup>
<p>Forward Channel Horizontal Opening /</p> <p>Reverse Channel Horizontal Opening</p>	<p>0.2UI / 0.2UI</p> 
<p>Forward Channel Vertical Opening /</p> <p>Reverse Channel Vertical Opening</p>	<p>25mV / 25mV</p> 

Note 1. This testing should use Maxim GMSL GUI & Evaluating Kits.

2. The Bathtub curve measures BER at 1e-3, 1e-6.

3. Horizontal and Vertical Bathtub Curve for 6Gbps forward and 187Mbps reverse channels.

\*SerDes : Serializer & Deserializer

\*BER : Bit Error Rate

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**5-4. Signal Timing Specifications**

Table 5 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.

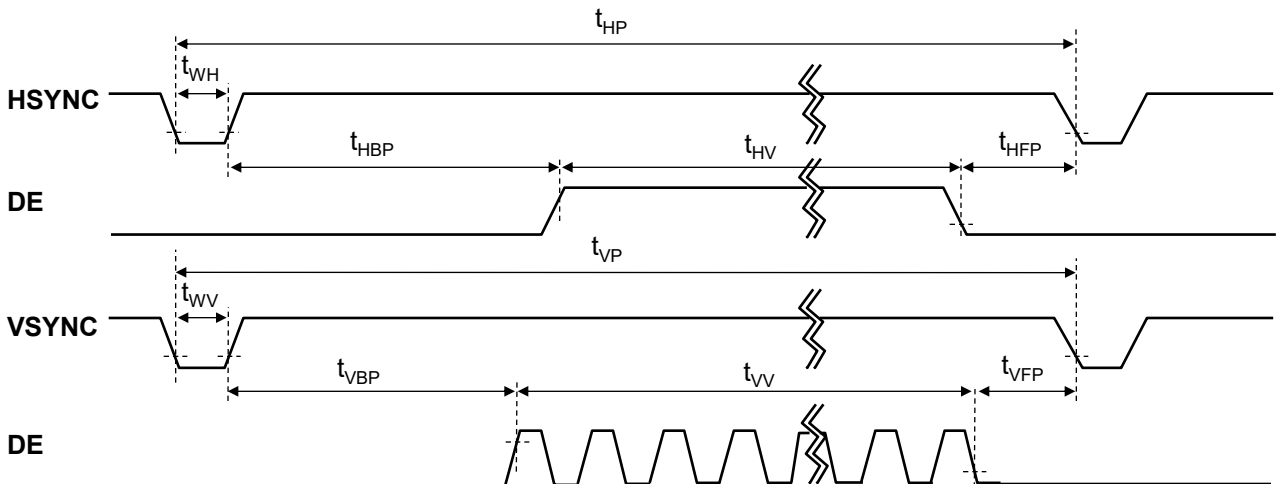
**Table 5-4-1. SIGNAL TIMING CHARACTERISTICS**

$f_v = 60\text{Hz}$

Parameter	Symbol	Min	Typ	Max	Unit	Note
DCLK	Frequency	$f_{\text{CLK}}$	117.13	120.93	126.67	MHz
	Period	$t_{\text{CLK}}$	7.89	8.27	8.54	ns
HSYNC	Period	$t_{\text{HP}}$	2656	2720	2800	$t_{\text{CLK}}$
	Width	$t_{\text{WH}}$	32	32	80	
	Horizontal Valid	$t_{\text{HV}}$	2560	2560	2560	
	Horizontal Back Porch	$t_{\text{HBP}}$	32	80	80	
	Horizontal Front Porch	$t_{\text{HFP}}$	32	48	80	
VSYNC	Period	$t_{\text{VP}}$	735	741	754	$t_{\text{HP}}$
	Width	$t_{\text{WV}}$	7	10	17	
	Vertical Valid	$t_{\text{VV}}$	720	720	720	
	Vertical Back Porch	$t_{\text{VBP}}$	5	8	10	
	Vertical Front Porch	$t_{\text{VFP}}$	3	3	7	

Note 1. The performance of the electro-optical characteristics may be influenced by variance of the vertical refresh rates.

2. The Refresh rates should be followed 60Hz regardless of the DCLK & HSYNC, VSYNC.



**FIG. 5-4-1 DE & SYNCN Timing Diagram**

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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.

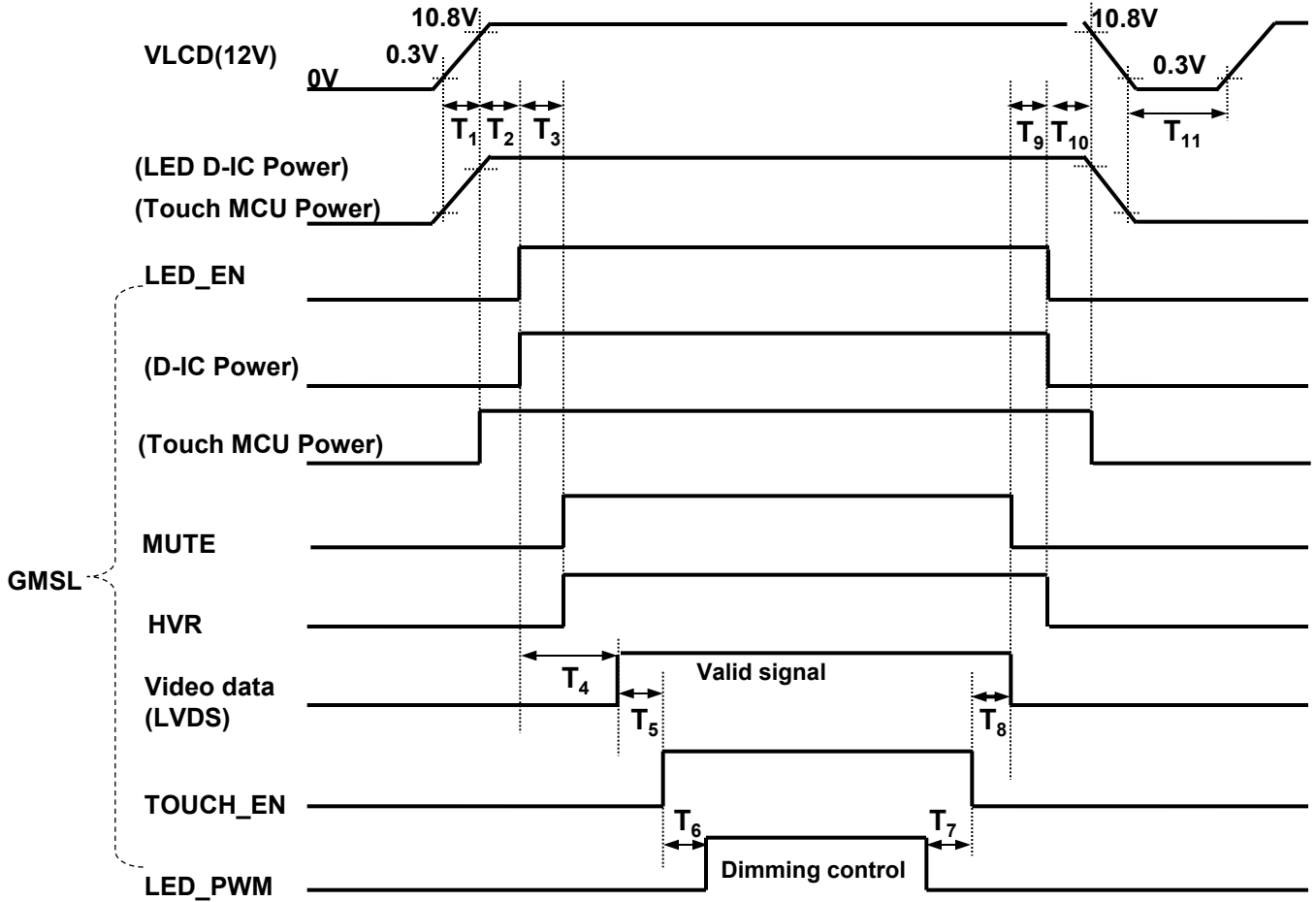
**Table 5-5-1. COLOR DATA REFERENCE**

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
<b>Basic Color</b>	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
<b>RED</b>	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
<b>GREEN</b>	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
<b>BLUE</b>	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 8. POWER ON SEQUENCE**

Parameter	Value			Unit	Note
	Min	Typ	Max		
T1	0.5	-	10	ms	Touch MCU & Deserializer & LED D-IC Power On
T2	10	-	-	ms	Deserializer Initializing & LCD D-IC Power On
T3	0	-	T4	ms	
T4	200	-	-	ms	
T5	17	-	-	ms	
T6	0	-	-	ms	
T7	0	-	T8	ms	
T8	10	-	-	ms	
T9	34	-	-	ms	
T10	0	-	-	ms	
T11	1000	-	-	ms	

- 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 VLCD to 0V.  
 3. Scanning direction of LCD should be decided before LVDS valid data signal input.  
 Do not change HVR status to avoid abnormal display during LCD operation.  
 4. Backlight must be turned on after power supply for LCD and interface signal are valid.  
 5. All signal of GMSL need to keep GND level stably before LCD power enable.  
 6. At low temperature operating, display can be slow.

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### 6. Touch

#### 6-1. Touch Specifications

**Table 6-1. General Specifications**

Item		Spec.	Note.
General Specification	Touch Panel Technology	Projected Capacitive Touch	
	Sensor Type	In-cell	AIT
	Touch IC	SW42103	Siliconworks
	Multi Touch Points	5 points	
	Active Touch Area [mm]	354.816(H) x 99.792(V)	
	Finger Size	9Φ	
	Interface	I2C	
	Touch Block	72 by 20	

**Table 6-2. 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	15			6Φ Finger (center to center)

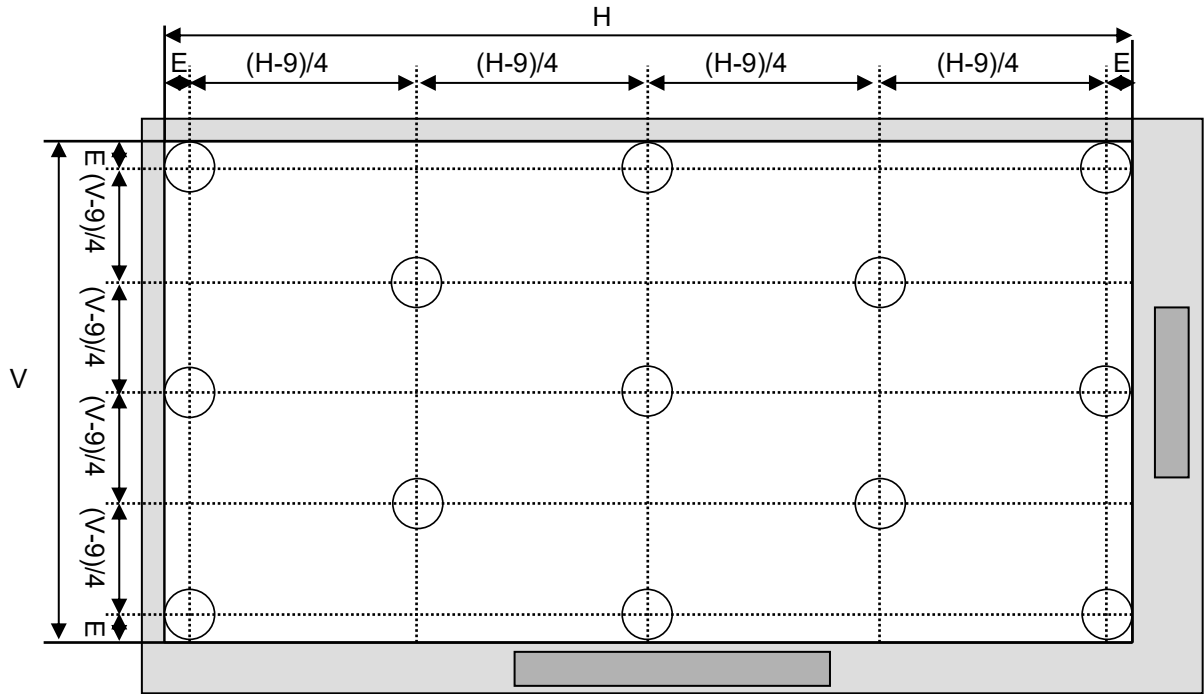
Note 1. All kind of specifications and functions are optimized with the below Test condition.

- . Report rate 60Hz@1-finger

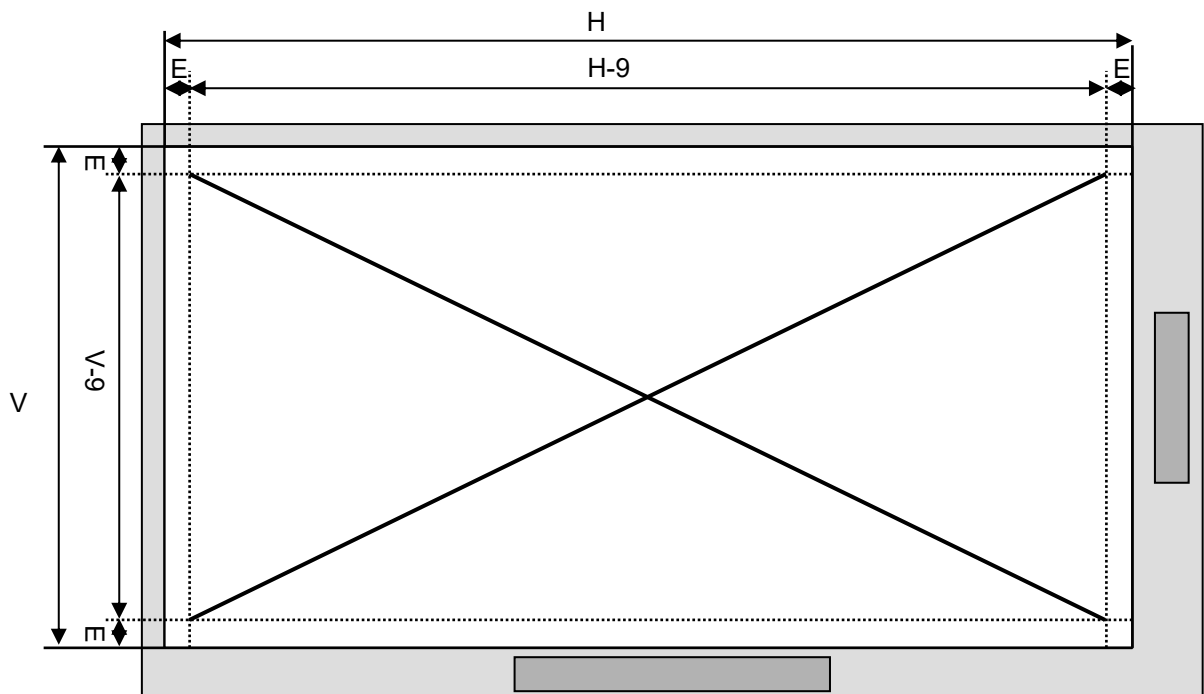
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Note 2. Touch Performance measurement

- Test Machine : MIK K9600
- Test Tip : 9Φ Slug
- E : 4.5mm(Test Tip Size/2)



**Fig 6-1. Accuracy Test**



**Fig 6-2. Linearity Test**

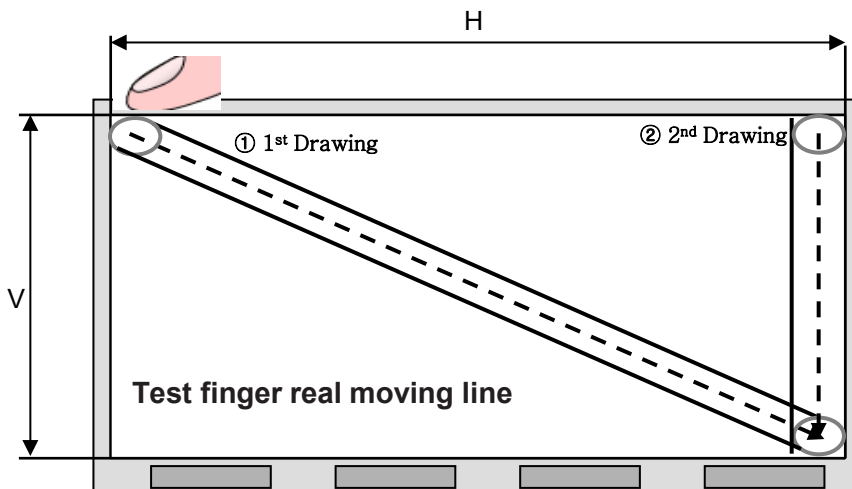
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**6-2. Touch Performance Test**

The Touch test shown below are processed by the final inspection machine in Nan-Jing LG Display Module Line.

**Table 6-2-1. Touch Performance Test List**

No.	Test	Evaluation method	Spec.
1	Version Check	F/W Version Check.	F/W: V00.09
2	Raw-data	Raw-data Min./Max. comparison about 10Frame of Raw-data.	500~3500
3	Open	Comparison of Raw-data value difference Calculations for the same column by MUX.	2000~4096
	Short		0~1000
4	Jitter	Extraction of the maximum variation in the raw-data of 240frame based on average value of raw-data of 60 frame.	Max 80
5	Drawing	Drawing along the line shown on the screen.	No Drawing Error



**FIG. 6-2-1. Drawing Test Method**

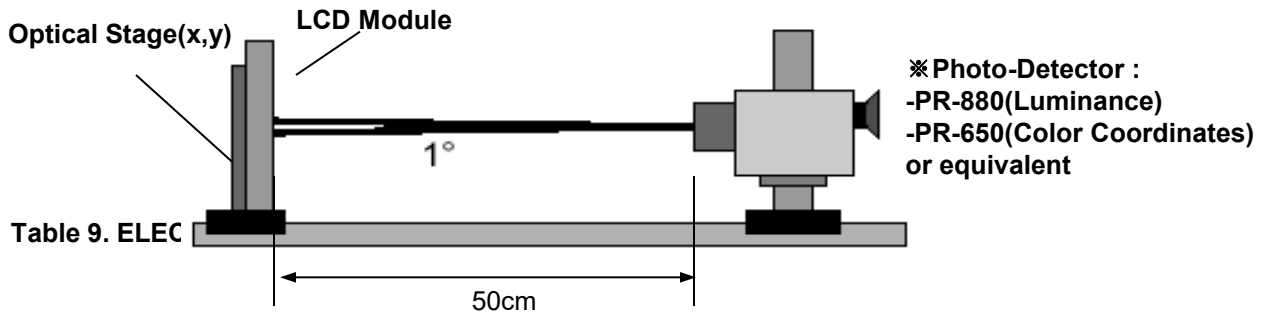


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**7. Electro-optical Characteristics**

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  $0^\circ$ . 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. 1.



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

**Table 7-1. ELECTRO-OPTICAL CHARACTERISTICS**  $T_a=25 \pm 2^\circ\text{C}$ ,  $V_{LCD}=12.0\text{V}$ ,  $f_{clk}=120.93\text{MHz}$ ,  $f_v=60\text{Hz}$

Parameter	Symbol	Value			Unit	Equipment	Note	
		Min	Typ	Max				
Contrast Ratio	CR@ perpendicular	900	1100	-	-	PR-880	1	
Surface Luminance, white	$L_{WH}$	540	675	-	cd/m <sup>2</sup>	PR-880	2	
White Uniformity	White @9point	80	-	-	%	PR-880	3	
Black Uniformity	Black @Area	40	-	-	%	LMK		
Response Time ( $T_a$ 기준)	$T_a=25^\circ\text{C}$	-	-	20	ms	RD-80S	4	
	$T_a=-20^\circ\text{C}$	-	-	150	ms			
	$T_a=-30^\circ\text{C}$	-	-	400	ms			
Color Coordinates [CIE1931]	RED	Rx	Typ -0.030	0.640	Typ +0.030	-	PR-650	
		Ry		0.330				
	GREEN	Gx		0.300				
		Gy		0.600				
	BLUE	Bx		0.150				
		By		0.060				
	WHITE	Wx		-0.008				0.293
Wy		0.320						
Color Gamut	-	-	70	-	%	PR-880		
Viewing Angle (CR>10)	x axis, right( $\phi=0^\circ$ )	$\theta_r$	-	89	-	degree	EZ-Contrast	5
	x axis, left ( $\phi=180^\circ$ )	$\theta_l$	-	89	-			
	y axis, up ( $\phi=90^\circ$ )	$\theta_u$	-	89	-			
	y axis, down ( $\phi=270^\circ$ )	$\theta_d$	-	89	-			
Gamma@ VESA 9point	-	2.0	2.2	2.4	-	PR-880	6	
Surface reflection	SCI	-	-	2.0	%			

**Product Specification**

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

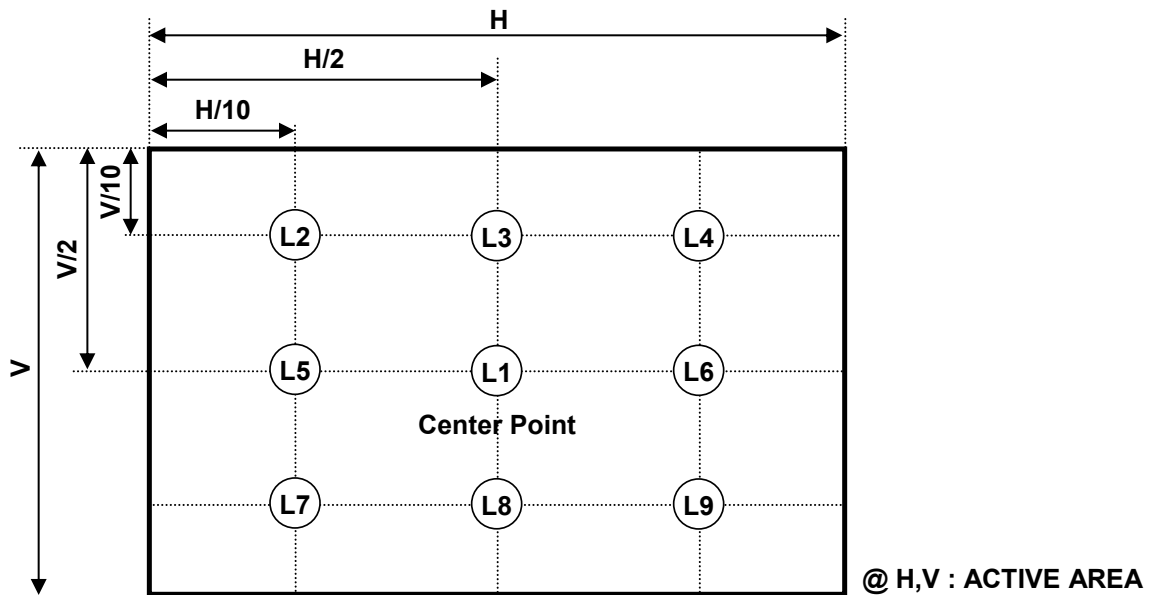
$$\text{Contrast Ratio} = \frac{\text{Surface Luminance with all white pixels}}{\text{Surface Luminance with all black pixels}}$$

It is measured at center 1-point.

- 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. 2.
- The luminance variation( $\delta_{\text{WHITE/BLACK}}$ ) is determined by measuring LN at each test position 1 through 9. The luminance variation( $\delta_{\text{WHITE/BLACK}}$ ) is defined as follows ;

$$\text{Luminance Variation } (\delta_{\text{WHITE/BLACK}}) = \frac{\text{Minimum}(L1, L2, \dots, L8, L9)}{\text{Maximum}(L1, L2, \dots, L8, L9)} \times 100 (\%)$$

For more information see the FIG. 2.



**FIG. 7-2 9 Points for Luminance Measure**

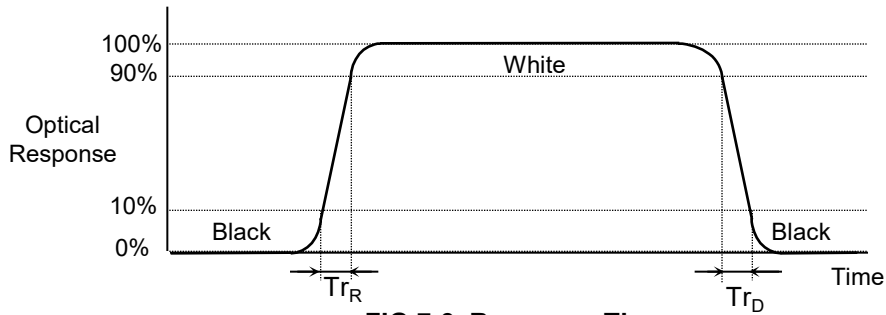
**Product Specification**

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 7-3.

5. Low temperature response time measure method

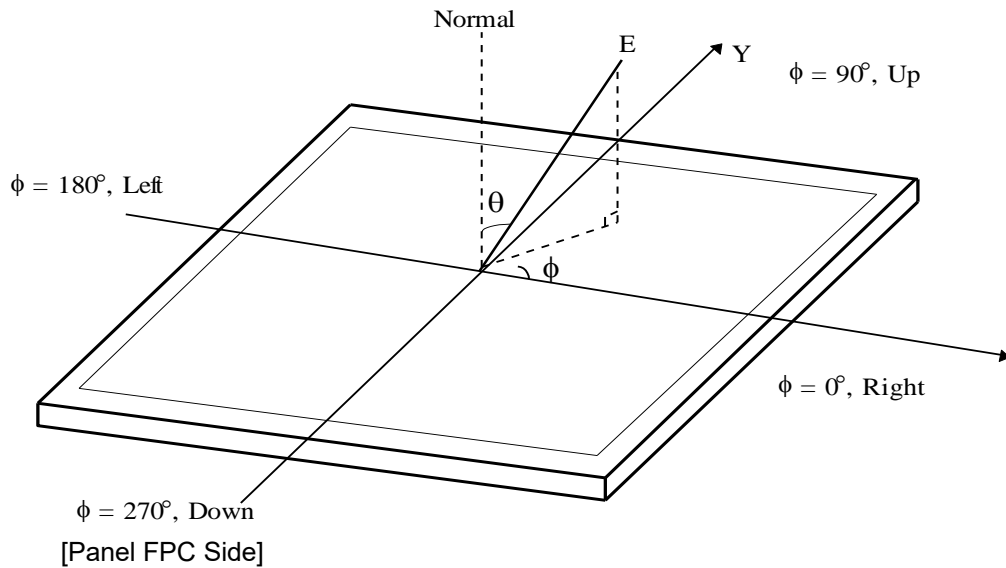
: The LCD panel has remained at low temperature(-20 °C or -30 °C)for 30 minutes and then kept turning on for 30 minutes before measured.

This is a part of design warranty. No additional management will be fulfilled for this in mass production.



**FIG.7-3 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. 7-4.



**FIG. 7-4 Viewing Angle**

7. Gamma is measured and evaluated according to “Information Display Measurements Standard” Version 1.03, 2012-07-01

- Measurements 9point: 255, 223, 191, 159, 127, 95, 63, 31, 0Gray

**Product Specification**

**8. 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.

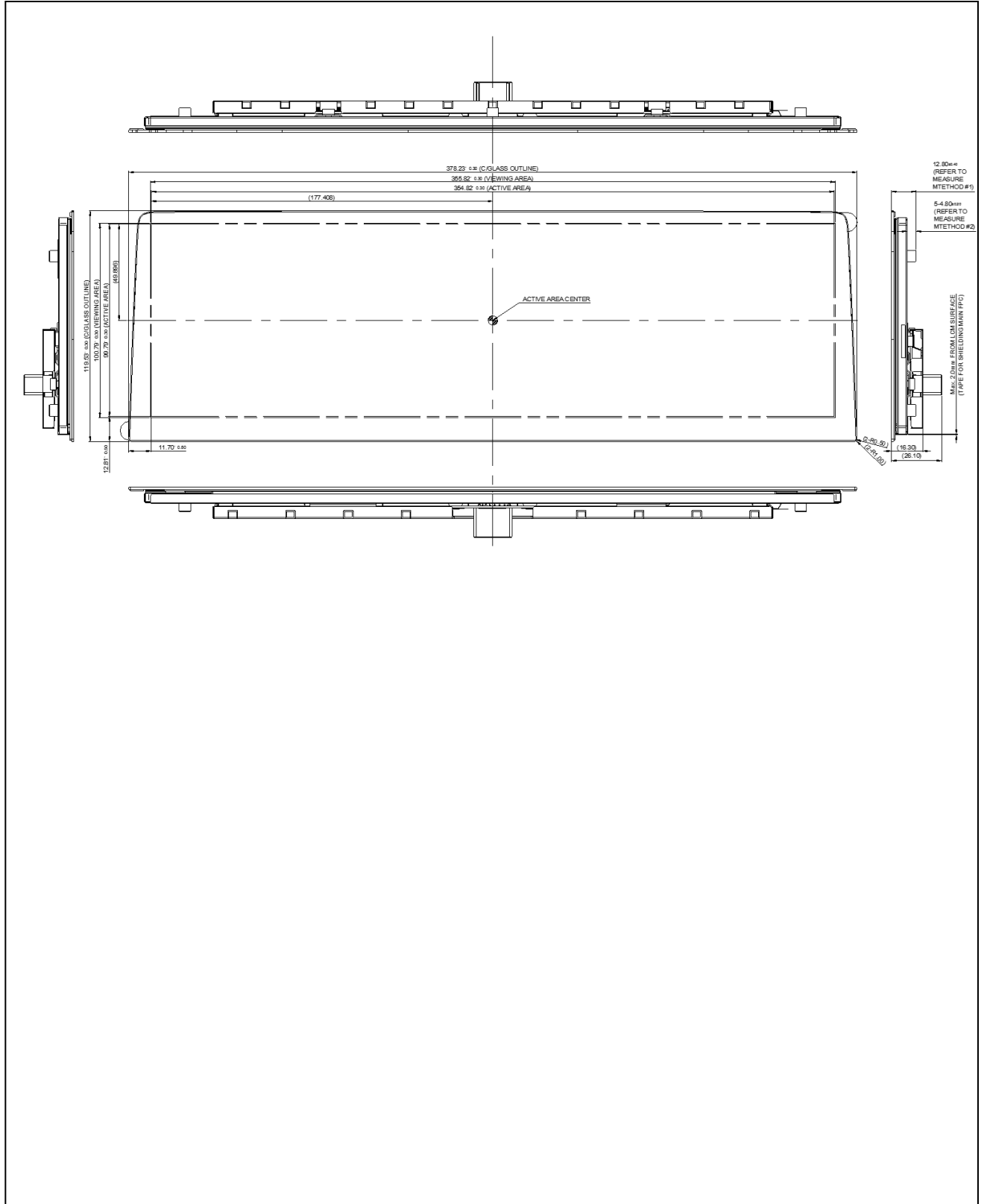
**Table 8-1. MECHANICAL CHARACTERISTICS**

Parameter	Value	
Outline Dimension (With Cover Glass)	Horizontal	361.82 ± 0.30 mm (LCM only)
	Vertical	112.4 ± 0.30 mm (LCM only)
	Depth	12.80 ± 0.40 mm (W PEM Nut)
Viewing Area	Horizontal	355.82± 0.30 mm
	Vertical	100.79± 0.30 mm
Active Display Area	Horizontal	354.82 ± 0.30 mm
	Vertical	99.79 ± 0.30 mm
Weight	595g (Typ.), 605g (Max.)	

Product Specification

<FRONT VIEW>

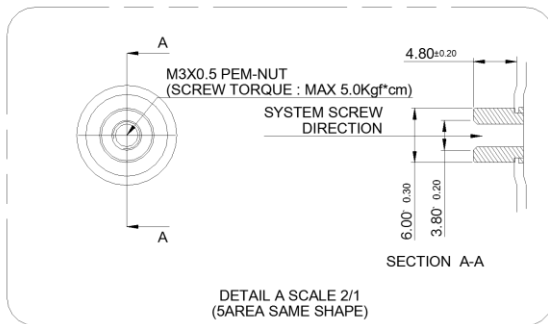
Note. Unit:[mm]



Product Specification

<REAR VIEW>

Note. Unit:[mm]



<Internal threads> Unit : mm

Name of screws	Pitch	Class	Minor diameter		Pitch diameter		Inner diameter	
			D1(Max)	D1(Min)	D2(Max)	D2(Min)	D3(Max)	D3(Min)
M3	0.5	6H	No Definition given		2.755	2.675	2.599	2.459

<External threads> Unit : mm

Name of screws	Pitch	Class	Minor diameter		Pitch diameter	
			D1(Max)	D1(Min)	D2(Max)	D2(Min)
M3	0.5	6g	2.98	2.874	2.655	2.58

PEM-NUT INFORMATION (ISO 965/2 STANDARD)

**Product Specification**

**9. Reliability**

**Table 11. ENVIRONMENT TEST CONDITION**

No.	Test Item	Test Condition	Note															
1	High Temperature Storage Test	Ta = 90℃ 240h	1,2															
2	Low Temperature Storage Test	Ta = -40℃ 240h	1,2															
3	High Temperature Operation Test	Ta = 85℃ 240h	1,2															
4	Low Temperature Operation Test	Ta = -30℃ 240h	1,2															
5	High Humidity Operation Test	Ta=65℃ / 90%RH 240h	1,2															
6	Humid Heat Cycle Test	Ta = -10℃~65℃ / 80~96%RH 240h	1,2															
7	Thermal Shock Test (non-operating)	- 1cycle : Ta = -40℃(0.5h) ~ 95℃(0.5h) - 240Cycles	1,2															
8	Electro Static Discharge Test	<table border="1"> <thead> <tr> <th colspan="3">Condition</th> <th colspan="2">judgment</th> </tr> </thead> <tbody> <tr> <td>Operating</td> <td>Air</td> <td>330pF, 2kΩ</td> <td>±15kV</td> <td>Level B</td> </tr> <tr> <td>Un-plug</td> <td>Contact</td> <td>150pF, 2kΩ</td> <td>±10kV</td> <td>Level A</td> </tr> </tbody> </table>	Condition			judgment		Operating	Air	330pF, 2kΩ	±15kV	Level B	Un-plug	Contact	150pF, 2kΩ	±10kV	Level A	1,2,3,4
		Condition			judgment													
Operating	Air	330pF, 2kΩ	±15kV	Level B														
Un-plug	Contact	150pF, 2kΩ	±10kV	Level A														
9	Shock Test (non-operating)	- Half sine wave, 50G, 11ms, three times - One in each opposite direction of each perpendicular axis																
10	Vibration Test (non-operating)	- 5Hz to 200Hz logarithm sweep for 20min/cycle - 5Hz to 12.2Hz : The amplitude is 10mm p-p - 12.2Hz to 100Hz : The acceleration is 3.0G 0-pk - 101Hz to 200Hz : The acceleration is 1.5G 0-pk - 3 axes, 18 sweeps per axis																

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. (No picture, Line defect, Out of synchronization)

\* Panels should become room temperature within 2hours.

\* Panels should be in dry status. (The humidity during reliability test should be disappeared.)

2. After conduct reliability tests, only functional FOS(Front of Screen) quality is guaranteed by naked eyes. It means there is no function failure problems such as abnormal display, line defect.

3. Electro Static Discharge Test measure method. Equipment (K2000 or equivalent level device) After ESD test, it should be no functional defect.

4. ESD Criteria

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

**Product Specification****10. International Standards****10-1. 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

**10-2. Environment**

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



**Product Specification**

**10. Packing**

**10-1. Designation of the Label**

a) Lot Mark



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

D : YEAR  
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**



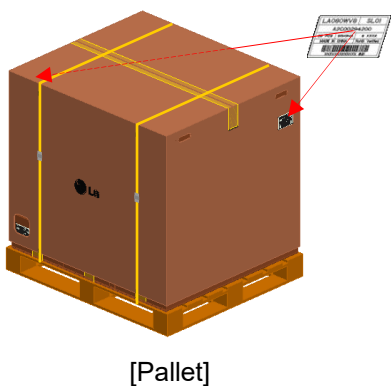
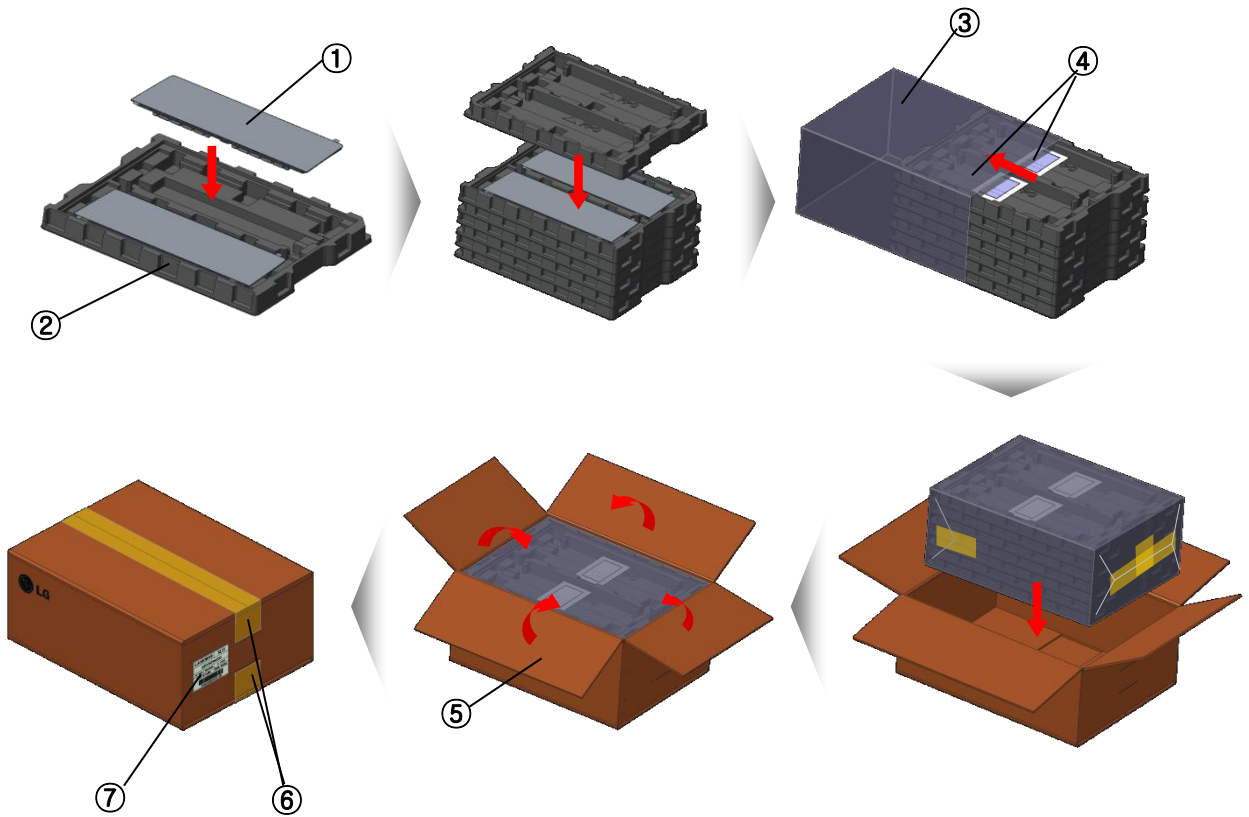
■ Customer 2D Barcode Information

Item	Information	Digit	Text mark or not	Remarks
Customer P/N	xxxxxxxxxx	11	O	Fixing data per each model, Need MMD information
Maker P/N	LA145WF1	8	O	Model name
Lot No	LGD Barcode Rule	13	O	LGD barcode rule

**Product Specification**

**11-2. Packing Form**

- a) Package quantity in one box: 12 pcs
- b) Box Size: 478 × 365 × 195 (mm)



NO.	Description	Material
1	Module	12pcs/1 Box
2	Packing, Tray	PET ESD Spec : 10 <sup>^</sup> 9Ω / □이하
3	Bag	PE ESD Spec : 10 <sup>^</sup> 12Ω / □이하
4	Desiccant	POWER DRY
5	Box	PAPER_SW
6	Tape	OPP
7	Box Label	YUPO

**Product Specification****12. PRECAUTIONS**

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

**12-1. MOUNTING PRECAUTIONS**

- (1) You should consider the assembling structure so that uneven force(ex. Twisted 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 the resist external force.
- (3) You should adopt radiation structure to satisfy the temperature specification.
- (4) Acetic acid type and chlorine type materials 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.
- (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 with chemical treatment.  
Do not touch the surface of polarizer for 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 soaks 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 PCB.
- (9) The ground of a PCB should be contacted to electrical ground of your system.
- (10) The metal case of a module should be contacted 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 :  
 $V = \pm 200\text{mV}$ (Over and under shoot voltage)
- (2) Response time depends on the temperature.(In lower temperature, it becomes longer.)
- (3) 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.
- (4) When fixed patterns are displayed for a long time, remnant image is likely to occur.
- (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.

## Product Specification

### 12-3. ELECTROSTATIC DISCHARGE CONTROL

Since a LCD panel is composed of electronic circuits, it is not strong 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

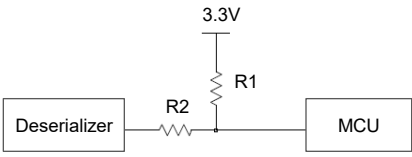
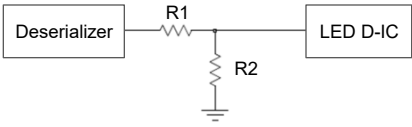
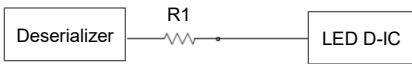
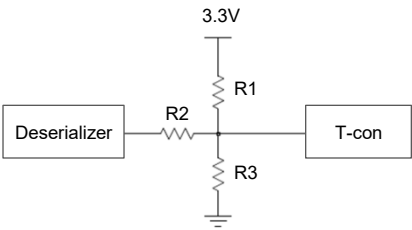
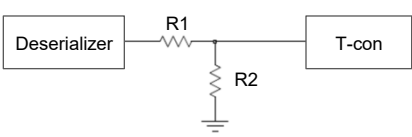
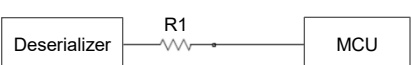
When storing LCD panel as spares for a long time, the following precautions are necessary.

- (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 such a 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) 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.
- (4) You can remove the glue and foreign material. 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.

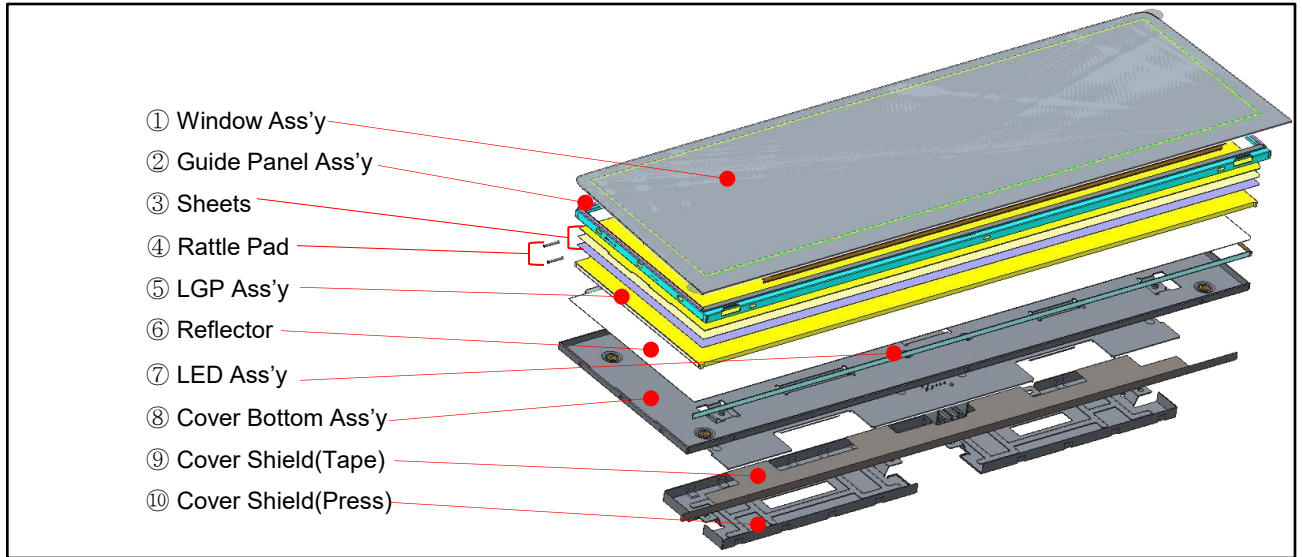
**Product Specification**
**# APPENDIX- I**
**■ Deserializer Equivalent Circuits**

MAX96752	Symbol	I/O	Description	Value	Note
GPIO10	TSP_RST	I		R1 : 10[k $\Omega$ ] R2 : 0[ $\Omega$ ]	
SCKIR	LED_PWM	I		R1 : 47[ $\Omega$ ] R2 : 4.7[k $\Omega$ ]	
SDIR	LED_EN	I		R1 : 47[ $\Omega$ ]	
SD/ADD0	ADD0_MUTE	I		R1 : Open R2 : 47[ $\Omega$ ] R3 : 4.7[k $\Omega$ ]	
GPIO02	LCD_TEST	I		R1 : 0[ $\Omega$ ] R2 : 4.7[k $\Omega$ ]	
WSIR	TSP_INT	I/O		R1 : 0[ $\Omega$ ]	

**Product Specification**

**# APPENDIX- II**

**■ LCM Construction**



No	Part Name	Part No	Q'ty	Specifiacaiton	Maker
①	Window Ass'y	6755L-0660A	1	Direct Bonding	LGD
②	Guide Panel Ass'y	4975L-1611A	1	Press, STS409HD(0.4T) + Tape(EAD 217+KVH 0,7T + EAD217), 0.96T 4ea + Tape(BDA-100), 0.1T 1ea +Tape Pad (KCC, SH0170U +TAPEX 5256M), 0.7T 2ea	Yeongdeng
③	Sheets	3401L-0037A 3032L-2985A 3022L-3759A	3	ALCF-A3+, HLAS-I05BA, TDW10C	3M LMS Toray
④	Rattle Pad	5022L-4167A	2	AD-5020FR(W), WHITE	Changsung
⑤	LGP Ass'y	5151L-0822A	1	PC, Flat, 2.55T	YJEN
⑥	Reflector	3034L-2552A	1	TCN225	Toray
⑦	LED Ass'y	6916L-3159B	1	T3014, 32ea	SSC
⑧	Cover Bottom Ass'y	3551L-1788A	1	AL5052, 1.0T + STS303F, Pemnut 5ea	Yeongdeng
⑨	Cover Shield(Tape)	3550S-2780A	1	LC50WB, 0.05T	Solueta
⑩	Cover Shield(Press)	3550S-2839A	1	STS409HD, 0.4T	Yeongdeng

## Product Specification

### # APPENDIX-III

#### ■ Thermistor Characteristics

Note 1. Thermistor type is NCP15XH103F0SRC

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. Rthermistor 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. Rthermistor tolerance is  $\pm 1\%$  at 25°C.

°C (Ta)	R <sub>thermistor</sub> [kΩ] (Thermistor)	R <sub>THER</sub> [kΩ] (LCM)
-30	113.35	109.10
-25	87.56	81.25
-20	68.23	59.90
-15	53.65	43.98
-10	42.51	32.24
-5	33.89	23.69
0	27.22	17.54
5	22.02	13.27
10	17.93	9.81
15	14.67	7.25
20	12.08	5.73
25	10 ± 1%	4.24
30	8.32	3.64
35	6.95	3.46
40	5.83	3.23
45	4.92	2.95
50	4.16	2.66
55	3.54	2.39
60	3.01	2.13
65	2.59	1.91
70	2.23	1.70
75	1.93	1.52
80	1.67	1.36
85	1.45	1.21