SPECIFICATION
FOR
APPROVAL

( ) **Preliminary Specification**
(◆) **Final Specification**

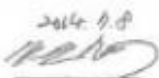| Title	16.4" Bar type TFT LCD

Customer	
MODEL	

SUPPLIER	LG Display Co., Ltd.
*MODEL	LB164WH1
Suffix	SJA1

*When you obtain standard approval,
please use the above model name without suffix

APPROVED BY	SIGNATURE
/	
/	
/	

Please return 1 copy for your confirmation with your signature and comments.

APPROVED BY	SIGNATURE
Y. T. Woo / G.Manager	2014. 9.8
REVIEWED BY	
K. H. Choi / Manager [C]	2014. 9.8
M. S. Kang / Manager [P]	
PREPARED BY	
T. I. Oh / Engineer	2014. 7.8

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

Product Specification

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RECORD OF REVISIONS

Revision No	Revision Date	Page	Description
0.0	Jul. 08. 2014	-	First Draft

Product Specification

1. Summary

This module utilizes amorphous silicon thin film transistors. The 16.4" active matrix liquid crystal display allows 16.7M colors to be displayed by LVDS interface is available.

2. Features

• The 16.4" screen produces a high resolution image that is composed of 325,108 pixel elements in a stripe arrangement.
• By adopting Wide viewing angle technology is employed.
• By adopting an active matrix drive, a picture with high contrast is realized.
• 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 6-bit + A-FRC gray scale signal.
• By adopting LVDS interface, the module has a good performance in terms of EMI.
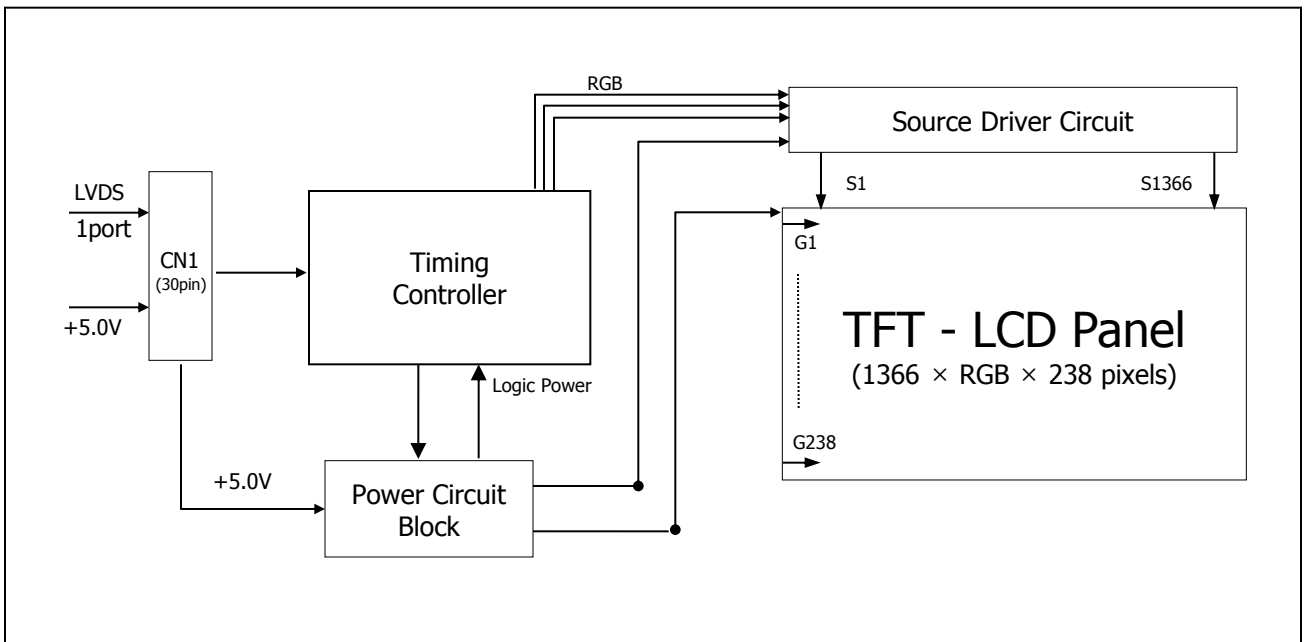
[Figure 1] Block diagram

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3.General Features

Active Screen Size	16.4 inches (415.974mm) diagonal
Outline Dimension	424.8(H) x 130.8V) x 1.8(D) mm(Typ.)
Pixel Pitch	0.100(H) mm x 0.300(V)mm
Pixel Format	1366 (H) By 238 (V) Pixels RGB stripes arrangement
Color Depth	6-bit+A-FRC, 16.7M colors
Transmittance	Typ. 4.4%
Power Consumption	Typ. 1.765W (mosaic pattern)
Weight	Typ. 119g
Display Operating Mode	Transmissive mode, normally black
Surface Treatment	Anti-glare 25%

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4. Absolute Maximum Ratings

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

Table 1. ABSOLUTE MAXIMUM RATINGS

Parameter	Symbol	Values		Units	Notes
		Min	Max		
Power Input Voltage	VCC	-0.3	6.0	Vdc	at 25 ± 5°C
Operating Temperature	TOP	0	50	°C	1
Storage Temperature	HST	-20	60	°C	1
Operating Ambient Humidity	HOP	10	90	%RH	1
Storage Humidity	HST	10	90	%RH	1

Note : 1. Temperature and relative humidity range are shown in the figure below.
Wet bulb temperature should be 39°C Max, and no condensation of water.
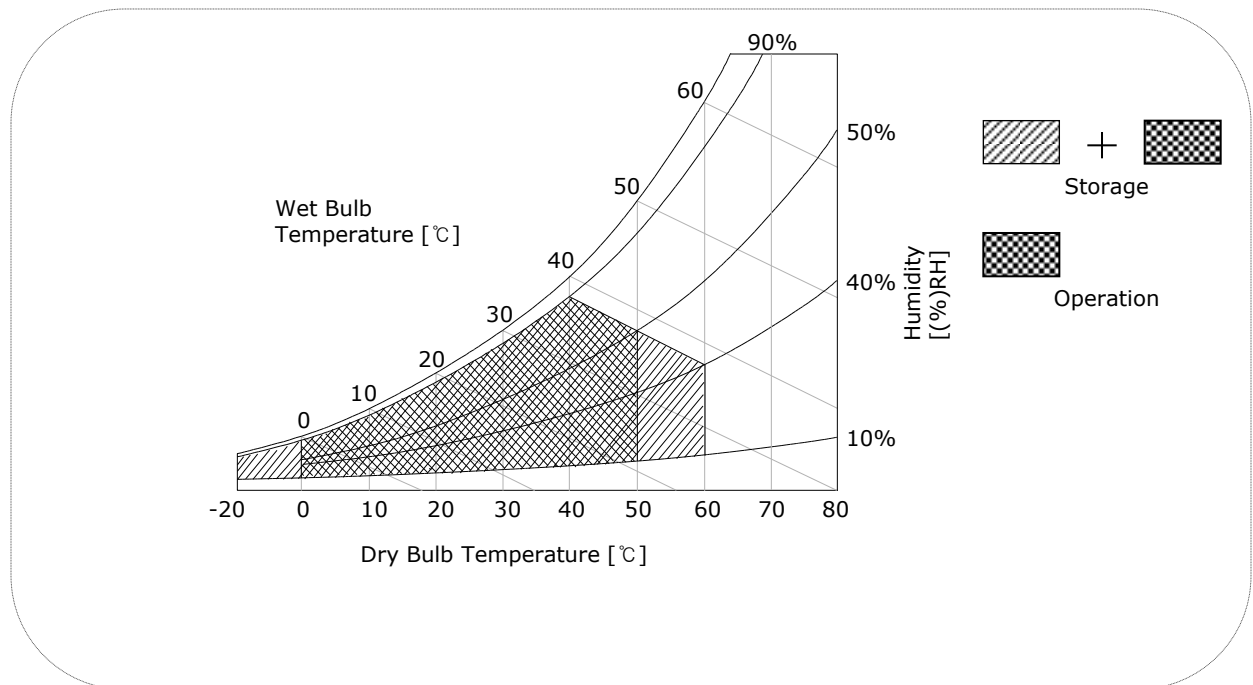
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5. Electrical Specifications

5-1. Electrical Characteristics

It requires one power inputs that is employed to power for the LCD circuit.

Table 2. LCD DRIVING CIRCUIT ELECTRICAL CHARACTERISTICS

Parameter		Symbol	Value			Unit	Note
			Min	Typ	Max		
Power Supply Voltage		V$_{LCD}$	4.5	5.0	5.5	V	
Power Supply Current	Mosaic(8x2)	I$_{LCD}$	265	353	460	mA	1
	White	I$_{LCD}$	295	393	511	mA	
Power Consumption	Mosaic(8x2)	P$_{LCD}$	-	1.765	2.53	Watt	
Rush Current		I$_{RUSH}$	-	-	2.0	A	2

Note 1. The specified current and power consumption are under the V$_{LCD}$=5.0V, Ta=25 $\pm$ 2°C, f$_V$=60Hz
  condition whereas mosaic pattern(8 x 6) and white pattern are displayed and f$_V$ is the frame frequency.
2. The duration of rush current is about 2ms and rising time of power input is 0.5ms (min.).
  (V$_{LCD}$=5.0V, Ta=25 $\pm$ 2°C, f$_V$=60Hz)
3. 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.

White : 255 Gray
Black :   0 Gray

White : 255 Gray

Mosaic Pattern(8 x 2)

White Pattern

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5-2. Interface Connections

This LCD module employs only one interface connections, 30-pin connector(CN1)

5-2-1. User Connector(CN1) Pin Configuration

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

Pin No	Name	I/O	Description
1	NC	-	No Connection (For LCD internal use only)
2	PWM_OUT	O	Reference signal for inverter control
3	NC	-	No Connection (For LCD internal use only)
4	GND	I	Ground
5	RX0-	I	Minus signal of channel 0 (LVDS)
6	RX0+	I	Plus signal of channel 0 (LVDS)
7	GND	I	Ground
8	RX1-	I	Minus signal of channel 1 (LVDS)
9	RX1+	I	Plus signal of channel 1 (LVDS)
10	GND	I	Ground
11	RX2-	I	Minus signal of channel 2 (LVDS)
12	RX2+	I	Plus signal of channel 2 (LVDS)
13	GND	I	Ground
14	RXCLK-	I	Minus signal of clock channel (LVDS)
15	RXCLK+	I	Plus signal of clock channel (LVDS)
16	GND	I	Ground
17	RX3_	I	Minus signal of channel 3 (LVDS)
18	RX3+	I	Plus signal of channel 3 (LVDS)
19	GND	I	Ground
20	NC	-	No Connection (For LCD internal use only, VCOM SCL)
21	NC	-	No Connection (For LCD internal use only)
22	NC	-	No Connection (For LCD internal use only, VCOM SDA)
23	GND	I	Ground
24	GND	I	Ground
25	GND	I	Ground
26	VLCD	I	Power Supply (5.0V)
27	VLCD	I	Power Supply (5.0V)
28	VLCD	I	Power Supply (5.0V)
29	VLCD	I	Power Supply (5.0V)
30	VLCD	I	Power Supply (5.0V)

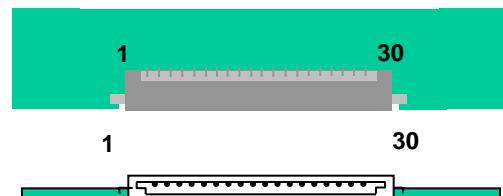**Rear view of LCM**

1. Connector

  1.1 LCD : GT103-30S-HF15-E250(LSM)

      or IS100-L30O-C23 (UJU)

  1.2 Mating :

    FI-X30H and FI-X30HL (JAE) or Equivalent

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Note:

      1. NC: No Connection.

       2. All GND(ground) pins should be connected together and to Vss which should also
         be connected to the LCD's metal frame.

      3. All V_{LCD} (power input) pins should be connected together.

      4. PWM_OUT is a reference signal for inverter control.
         This PWM signal is synchronized with vertical frequency.
         Its frequency is 3 times of vertical frequency, and its duty ratio is 50%.
         If the system don't use this pin, do not connect.

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5-3. 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. SIGNAL TIMING CHARACTERISTICS

| Parameter		Symbol	Min.	Typ.	Max.	Unit	Notes
D_{CLK}	Period	t_{CLK}	11.1	13.0	16.2	ns	
	Frequency	f_{CLK}	61.6	77.0	90.0	MHz	
Horizontal	Horizontal Valid	t_{HV}	1366	1366	1366	t_{CLK}	
	H Period Total	t_{HP}	1462	1608	2044		
	Hsync Frequency	f_H	38.3	47.9	62.0	kHz	
Vertical	Vertical Valid	t_{VV}	768	768	768	t_{HP}	
	V Period Total	t_{VP}	776	798	1108		
	Vsync Frequency	f_V	48	60	76	Hz	
DE (Data Enable)	DE Setup Time	t_{SI}	4	-	-	ns	For D_{CLK}
	DE Hold Time	t_{HI}	4	-	-		
Data	Data Setup Time	t_{SD}	4	-	-	ns	For D_{CLK}
	Data Hold Time	t_{HD}	4	-	-		

Note:
1. DE Only mode operation. The input of Hsync & Vsync signal does not have an effect on LCD normal operation.
2. The performance of the electro-optical characteristics may be influenced by variance of the vertical refresh rates.

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5-3-1. Signal Timing Waveforms

1. D$_{CLK}$, DE, DATA waveforms
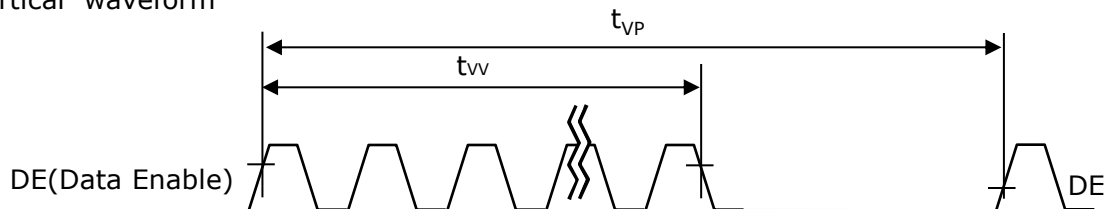
t$_{CLK}$

Dclk

t$_{SD}$ t$_{HD}$ Valid

Invalid

Data

t$_{SI}$ t$_{HI}$ Invalid

DE(Data Enable)
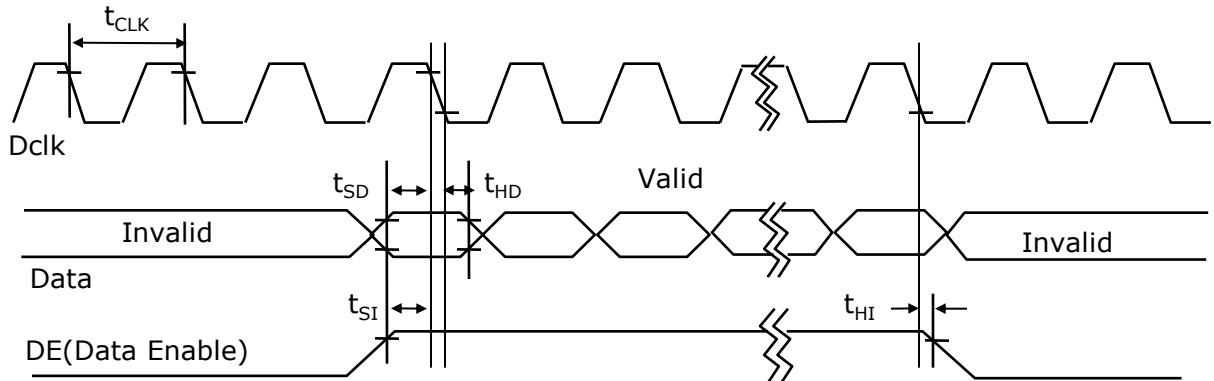
2. Horizontal waveform

t$_{HP}$

t$_{HV}$

DE(Data Enable)   DE
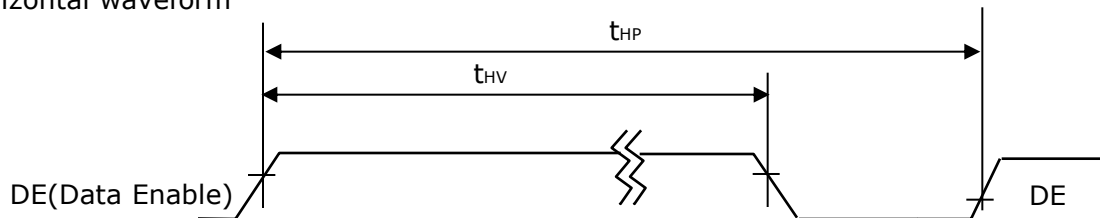
3. Vertical waveform

t$_{VP}$

t$_{VV}$

DE(Data Enable)   DE

5-4. LVDS Signal Specifications

5-4-1. DC Specification

|V_ID| = |(LVDS+) − (LVDS-)|
V_CM = {(LVDS+) + (LVDS-)}/2
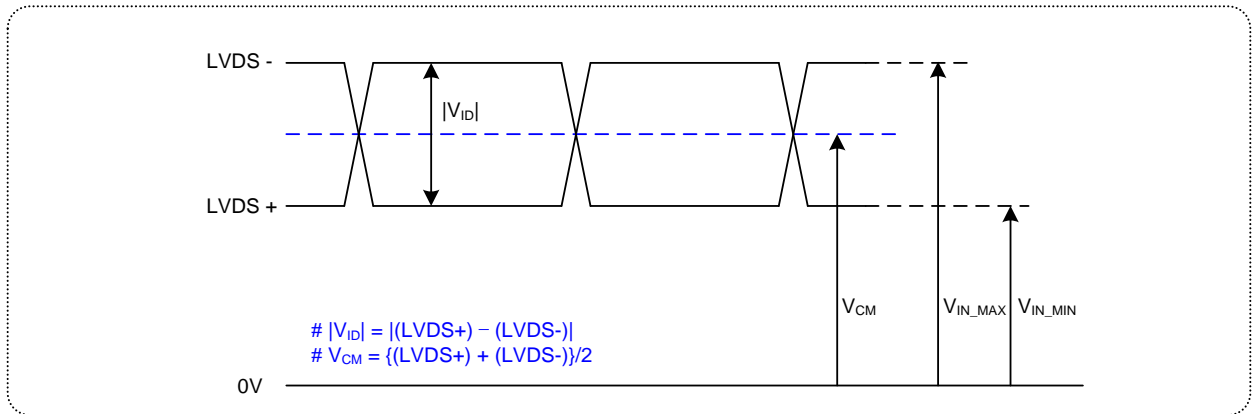
Description	Symbol	Min	Max	Unit	Notes
LVDS Differential Voltage	$|V_{ID}|$	100	600	mV	-
LVDS Common mode Voltage	V_{CM}	0.6	1.5	V	-
LVDS Input Voltage Range	V_{IN}	0.3	1.8	V	-
Change in common mode Voltage	ΔV_{CM}	-	250	mV	-
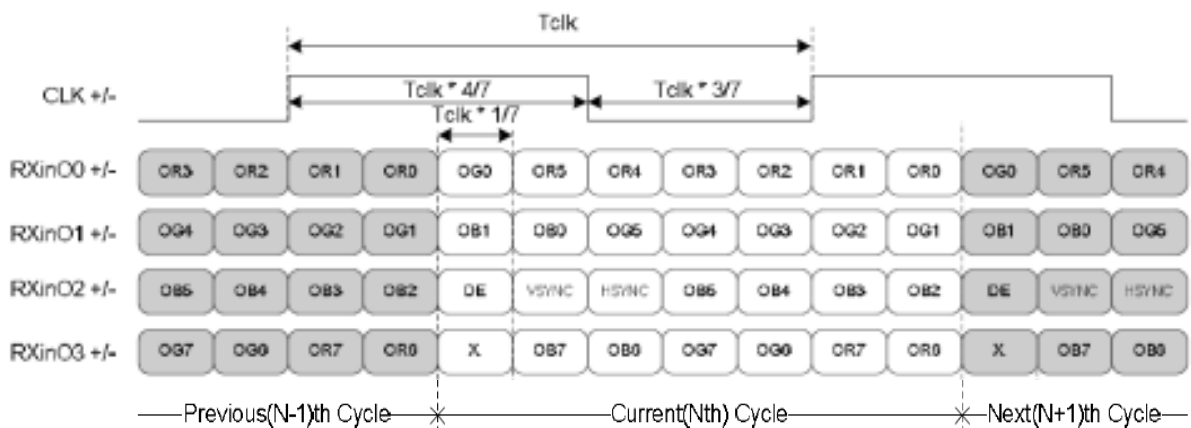
5-4-2. AC Specification

Parameter	Symbol	Min	Max	Unit	Notes
LVDS Clock to Data Skew Margin	t_{SKEW}	-400	+400	ps	85MHz > F_{clk} ≥ 65MHz
Maximum deviation of input clock frequency during SSC	F_{DEW}	-	±3	%	-
Maximum modulation frequency of input clock during SSC	F_{MOD}	-	200	KHz	-
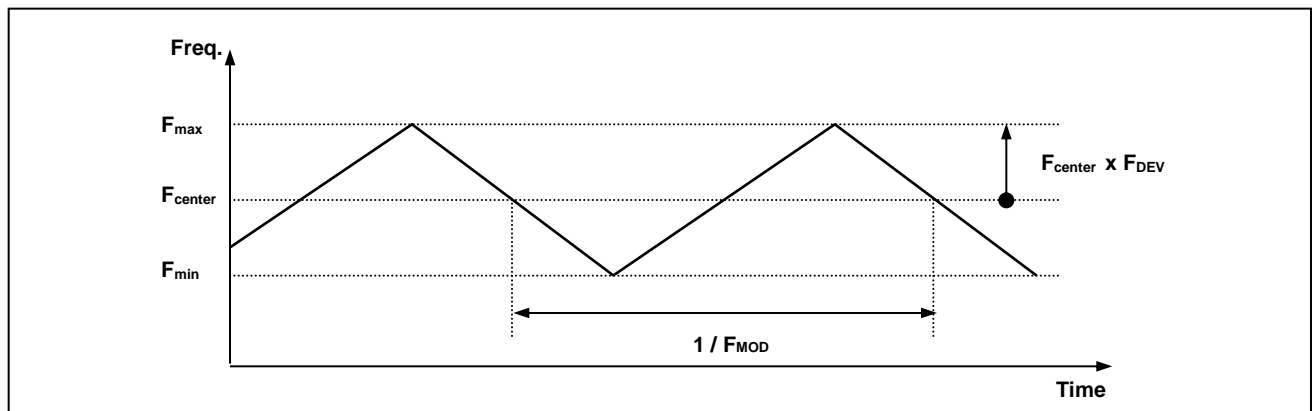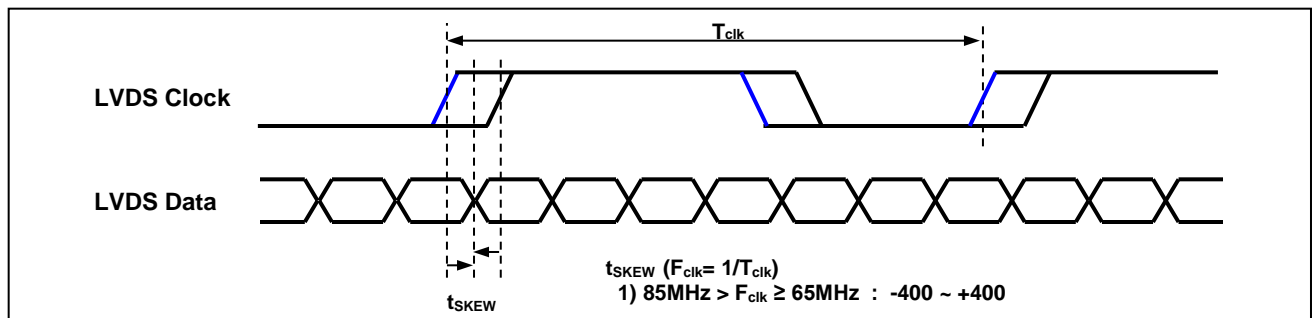
< Spread Spectrum >

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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 MSB							LSB	GREEN MSB							LSB	BLUE 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 (000) Dark	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 (001)	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 (000) Dark	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 (001)	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 (000) Dark	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 (001)	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 9. Power sequence
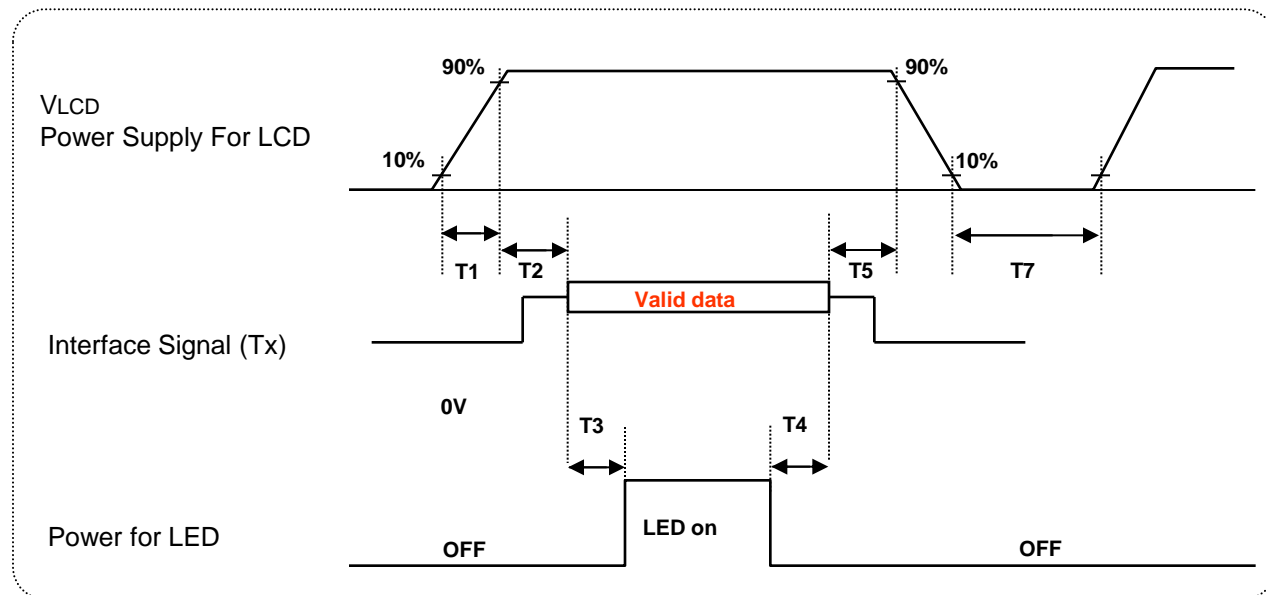
Parameter	Values			Units
	Min	Typ	Max	
T1	0.5	-	10	ms
T2	0.01	-	50	ms
T3	500	-	-	ms
T4	200	-	-	ms
T5	0.01	-	50	ms
T7	1	-	-	s

Notes :

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
   LCD V_{LCD} to 0V.
3. LED power must be turn on after power supply for LCD an interface signal are valid.

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5-7. Control of VCOM voltage

Table 9. The Control of VCOM voltage

Parameter	Unit	min.	Typ.	Max.	Notes
Inversion method	-	Horizontal 2 dot inversion(normal pattern)			1
Control Pattern/Gray		FIG.7 @ 127 gray			1
The optimized point	-	Center			
Offset	-	無			
Slave Address	byte	MSB 0 1 0 1 0 0 0 R/W LSB			
Control range	Level (step)	0	64	127	1,2
	Voltage(V)	4.51V	4.99V	5.47V	

1. Fig.7 is the pattern for control & inspection. This pattern made the optimized display about Flicker by FRC ,etc..
2. Signal sequence : This sequence must applied the below spec for IC Damage.
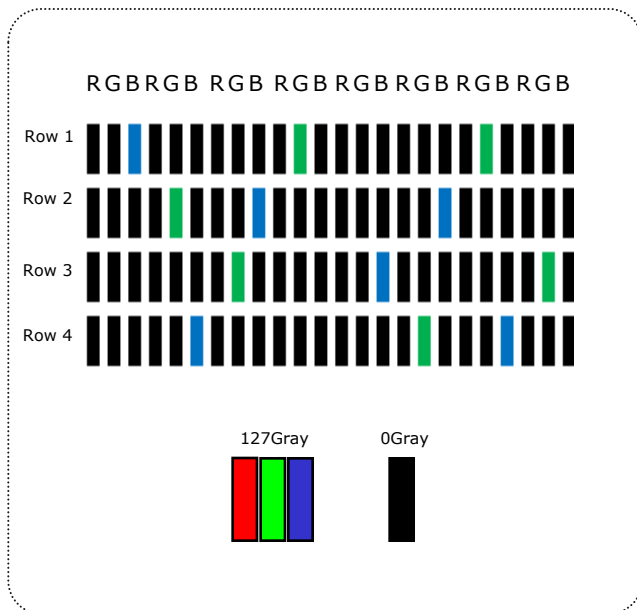   -. VCC → VDD → Control signal (SCL /SDA)
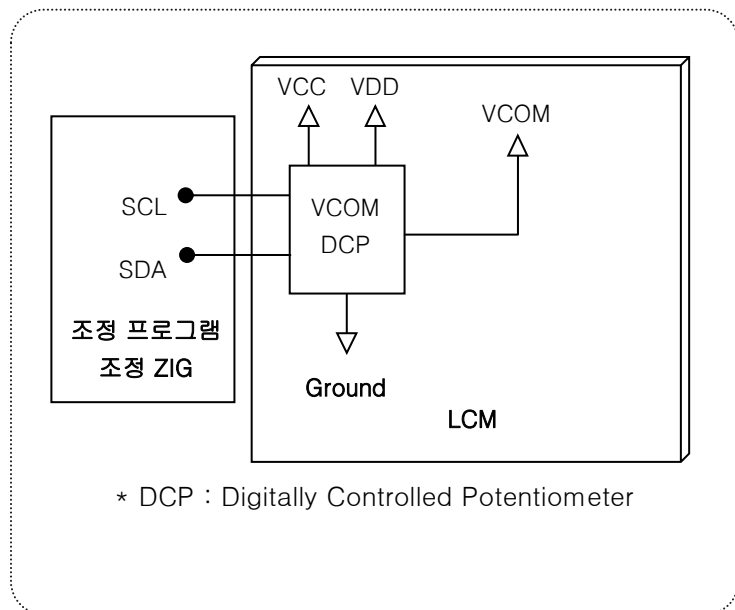

FIG. 7 The Pattern of VCOM control

* DCP : Digitally Controlled Potentiometer

FIG. 8 VCOM Block Diagram

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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±2°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 15 minutes while backlight turning on.

It is presented additional information concerning the measurement equipment and method in FIG. 1.
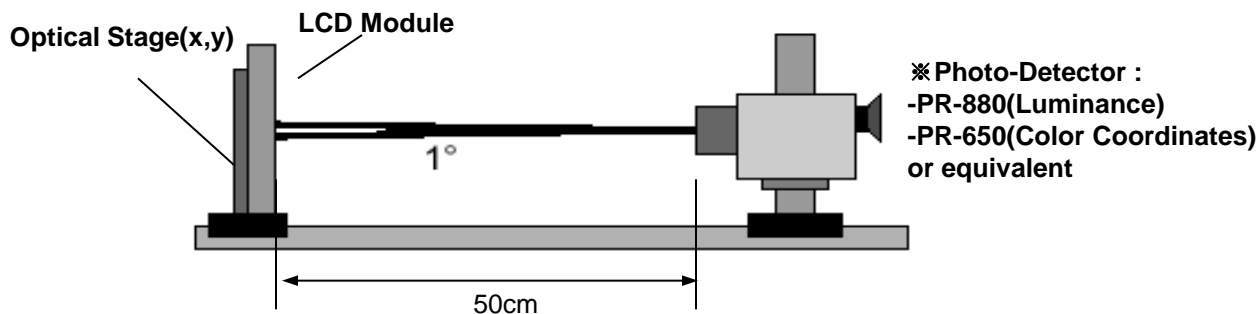

Optical Stage(x,y)   **LCD Module**

1°

50cm

※**Photo-Detector :**
-PR-880(Luminance)
-PR-650(Color Coordinates)
or equivalent

FIG. 3 Electro-optical Characteristic Measurement Equipment and Method

Table 8. ELECTRO-OPTICAL CHARACTERISTICS   Ta=25±2°C, VLCD=5.0V, fv=60Hz

Parameter		Symbol	Value			Unit
			Min	**Typ**	**Max**	
Contrast Ratio		CR	-	1000	-	
Transmittance		T(%)	3.74	4.4		%
Response Time	Gray to Gray	T_{GTG_AVR}	-	14	28	ms
Color Gamut			-	72	-	%

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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 15 Minute 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. 4.

3. The Gray to Gray response time is defined as the following figure and shall be measured by switching the input signal for "Gray To Gray ".
   - Gray step : 5 Step
   - TGTG_AVR is the total average time at rising time and falling time for "Gray To Gray ".

Table. 10 GTG Gray Table

Gray to Gray		Rising Time				
		G255	G191	G127	G63	G0
Falling Time	G255					
	G191					
	G127					
	G63					
	G0					

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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	424.8 mm
	Vertical	130.8 mm
	Depth	1.8 mm
Active Display Area	Horizontal	409.8 mm
	Vertical	71.4 mm
Weight	Typ. 119g	
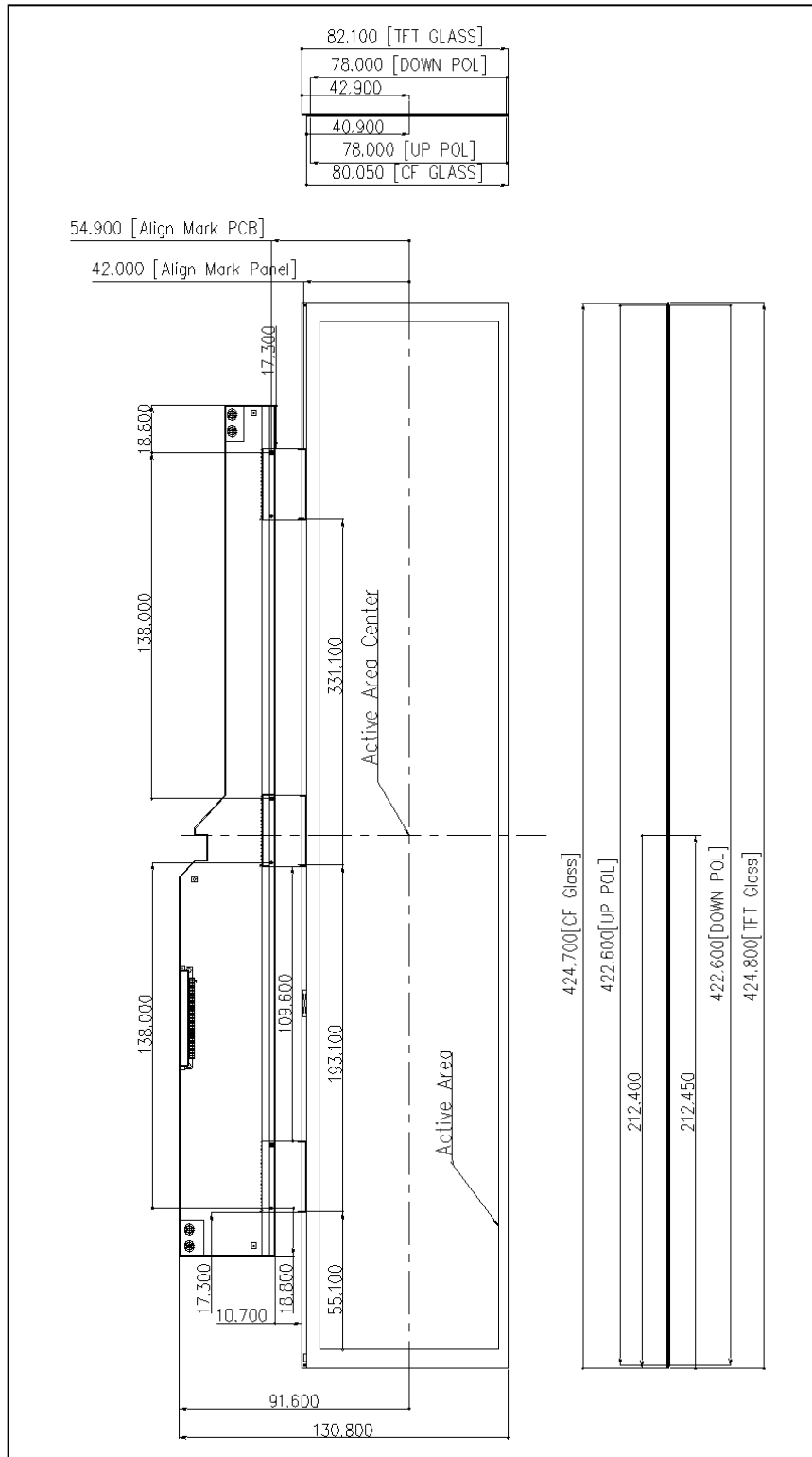
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<FRONT VIEW>

8. Reliability

Table 10. ENVIRONMENT TEST CONDITION

No.	Test Item	Conditions
1	High temperature storage test	Ta= 60°C, 240h
2	Low temperature storage test	Ta= -20°C, 240h
3	High temperature operation test	Ta= 50°C 50%RH 240h
4	Low temperature operation test	Ta= 0°C, 240h
5	Altitude operating storage / shipment	0 ~ 10,000 feet (3,048m) 24Hr 0 ~ 40,000 feet (12,192m) 24Hr

9. International Standards

9-1. Environment

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

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10. Packing

10-1. Designation of Lot Mark

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	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.

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10-2. Packing Form

a) Package quantity in one box : 16 pcs
b) Box Size : 572 mm × 372 mm × 162 mm
c) Pallet Pattern : 2 x 2 x 6
d) Quantity in one pallet : 384 pcs

x 16EA
(384EA)

x 9EA
(216EA)
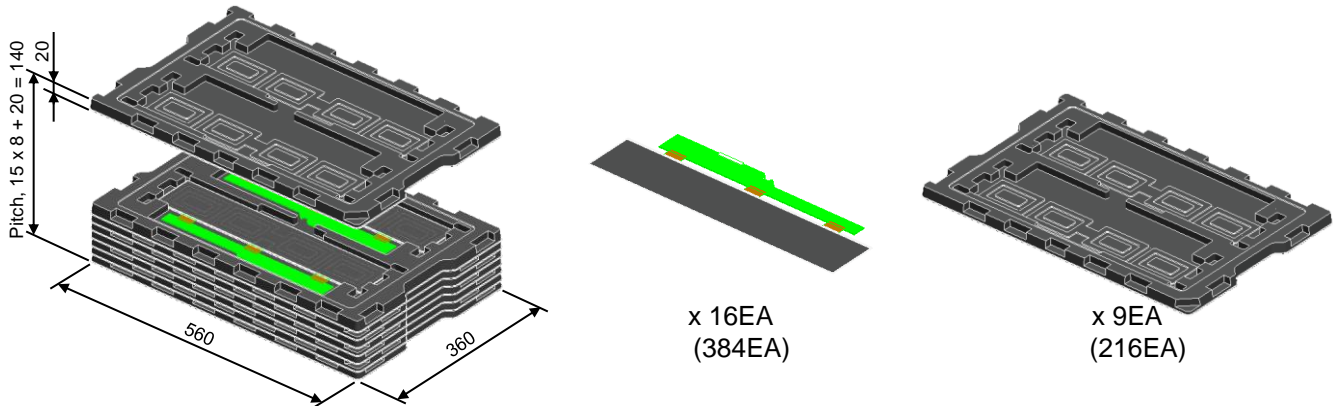
Dimension (mm)	B/Ass'y			1-Box			1-Pallet			Palletizing Pattern		
	L	W	H	L	W	H	L	W	H	L	W	H
	424.8	130.8	1.8	572	372	162	1,190	790	1,100	2	2	6
Remark	TBD			16EA (B/Ass'y)			384EA (B/Ass'y)			CBM : 1.03411 ㎥		
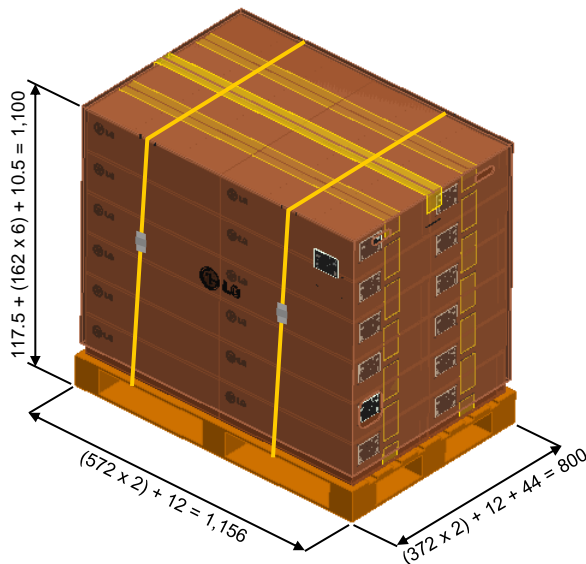
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11. PRECAUTIONS

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 the 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=±200mV(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.
(7) User CNT must be connect before Power on Sequence
When user CNT connect after Power on sequence, LCD module will be damaged

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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.

11-7. PRECAUTIONS FOR ATTACHING THE TOUCH PANEL PROCESS

(1) When being touch panel laminate, Stems, Scratch, Stain and etc. can be occurred and then the operation should be with care. After being attached touch panel, It is not warranty for quality problems