LG Display

Product Specifications

SPECIFICATION
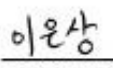# FOR
APPROVAL

( ) Preliminary Specification
(●) Final Specification

Title	3.5" qVGA (320 X RGB X 240) TFT - LCD

BUYER	
MODEL	

SUPPLIER	LG Display Co., Ltd.
MODEL	LB035Q03
SUFFIX	TD02

SIGNATURE	DATE
/	
/	
/	

APPROVED BY	DATE
J.D. KIM / G.Manager	
REVIEWED BY	11.02.01
D.H. JANG / S.Manager	
PREPARED BY	11.02.01
E.S. LEE / Engineer	
	11.02.01

Product Engineering Dept.
LG Display Co., Ltd

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RECORD OF REVISIONS

| Revision No.	Revision Date	Page	Summary
0.0	Sep. 2. 2010	-	First Draft (Preliminary)
0.1	Nov. 3. 2010	5	Delete the temperature condition row
		4, 7, 9	Change the LED symbol - V_{LED} → Anode, FB → Cathode
		9	Delete the temperature condition. (Ta=25℃) Add LED derating curve
		14	Correct the Notes 3 for explaining of optical measurement condition
		24	Delete the phrase of corresponding to CCFL backlight (11-2. OPERATING PRECAUTIONS (2))
1.0	Jan. 18. 2011	5	Update the Absolute Maximum Rating - I_{RUSH} value & measurement condition (Notes 1)
		8	Update the Electrical Characteristics - I_{CC} Typ. & Max. value
		9	Update the LED Electrical Characteristics - Change V_{LED}, P_{LED} Min. & Typ. & Max. Value - Change contents about Notes 1 & Notes 2 - Add Notes 3 & Notes 4
		21	Delete the phrase of 9-1. Safety
		23	Change the Packing From - Packing Q'ty in one box: 54 pcs → 48 pcs
1.1	Feb. 01. 2011	9	Update the LED Electrical Characteristics - Delete the Notes 1. - Change the phrase of string → chain on Notes 2. and Table - Rearrange Notes
		19	Correct the Rear View Drawing - FPC PIN No.(No.40 ~ No1 → No.1 ~ No.40)
		25	Delete the phrase of 11-6. HANDLING PRECAUTIONS FOR PROTECTION FILM
		-	Final Specification.

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1. Summary

This module utilizes amorphous silicon thin film transistors and a aspect ratio of 4:3. The 3.5" active matrix liquid crystal display allows 262,144 colors to be displayed by Digital RGB signal(18bit TTL level) input interface is available. The applications are display for cluster display for vehicle.

2. Features

• The 3.5" screen produces a high resolution image that is composed of 76,800 RGB pixel elements in a stripe arrangement.
• Technology of wide viewing angle is employed.
• By adopting an active matrix drive, high contrast picture or image is realized.
• By using of COG mounting technology, the module became thin, light and compact.
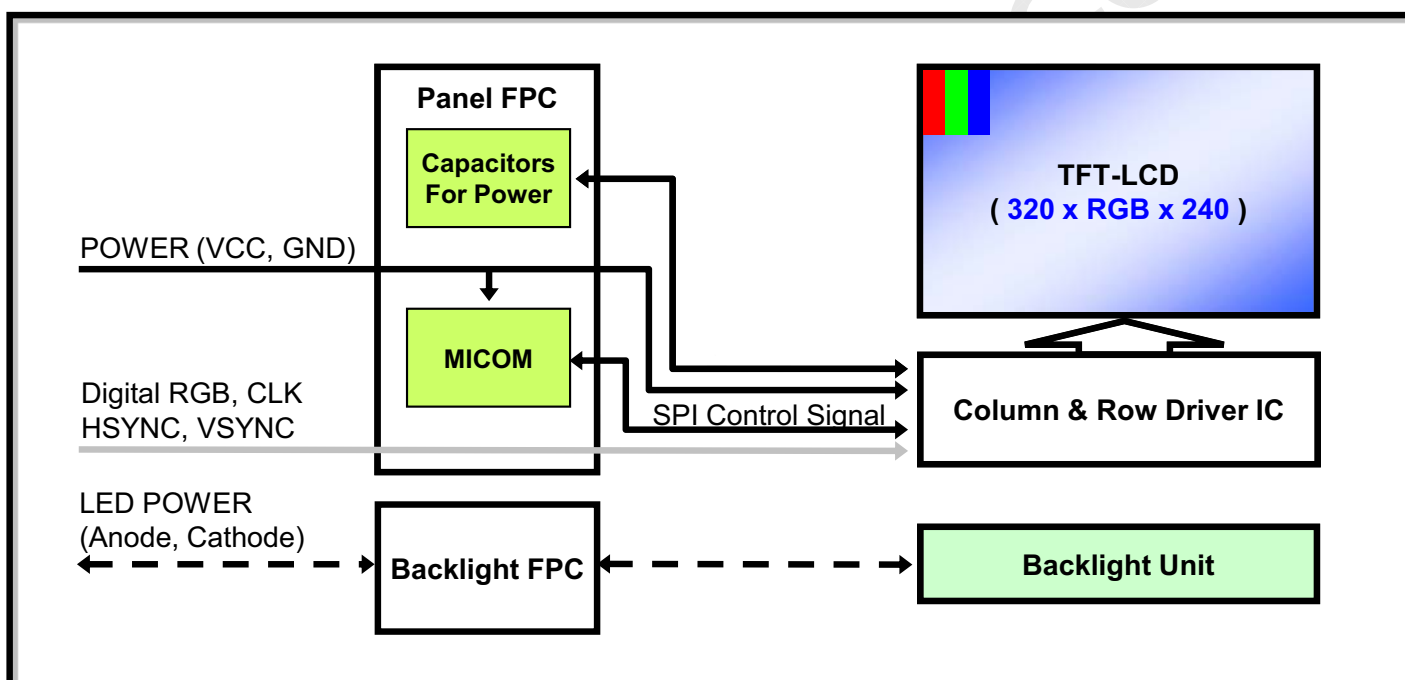
3. General Features   @T$_a$=25℃, Aging time: Over 10 minutes

|	
Active Screen Size	3.5 Inches Diagonal
Outline Dimension	84mm (H) X 67mm (V) X 6.7mm (T) (Typ.)
Pixel Pitch	0.219mm × 0.219mm
Pixel Format	320(H) X 3(R,G,B) X 240(V), RGB Vertical Stripes
Color Depth	6-bit, 262,144 Colors
Luminance, White	500 cd/m^2(Min.)
Weight	65g(Max.)
Display Operating Mode	TN mode, Normally White
Surface Treatment	Anti-Glare
Main Viewing Direction	12 o'clock

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4. Absolute Maximum Rating

The followings are maximum values which, if exceeded, may cause malfunction or damage to the Module.

Parameter	Symbol	Min.	Max.	Unit	Notes
Logic Voltage	VCC	-0.3	3.6	Vdc	
Inrush Current	I_{RUSH}	-	1.5	Apeak	1
Digital Input Signals	R0-R5 G0-G5 B0-B5 HSYNC VSYNC DCLK, DE	-0.3	3.6	Vdc	
Storage Temperature	T_{ST}	-40	85	℃	2
Operating Temperature	T_{OP}	-30	85	℃	2,3,4

Notes:

1. Measure condition: VCC=3.3V, VCC rising rate=150mV/μs
2. Maximum wet-bulb temperature is 58℃. Condensation of dew must be avoided, because it may cause electrical current leakage, and deterioration of performance and quality.
3. 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.
4. 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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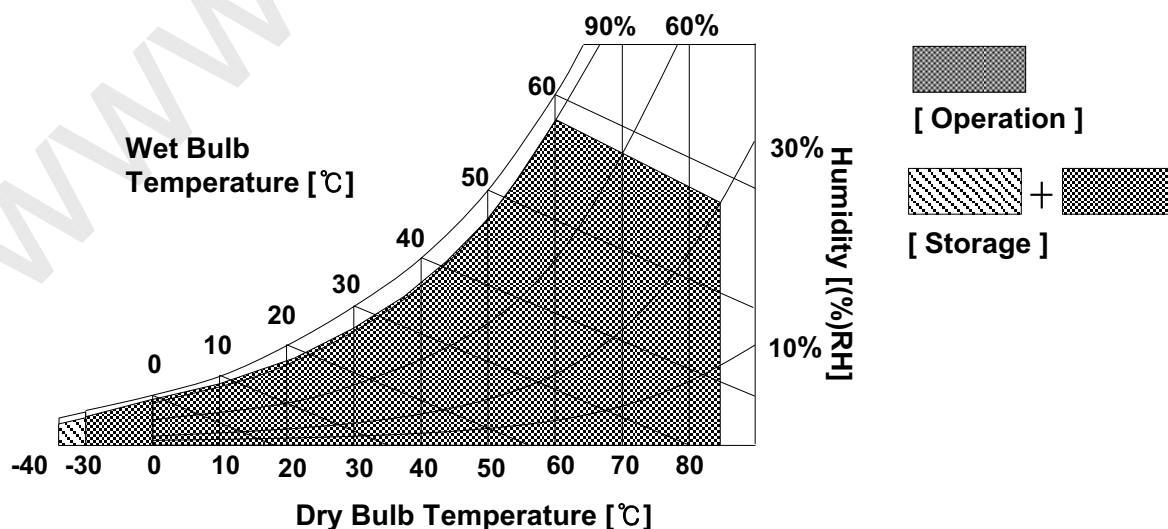
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5. Electrical Specifications

5-1. FPC pin assignment

This LCD employs two interface connections, one FPC is used for the module electronics interface and the other FPC is used for the integral backlight system.

5-1-1. Panel FPC Pin Configuration

The matching connector model name is FH28-40S-0.5SH manufactured by HIROSE or equivalent.

Pin	Symbol	I/O	Description	Notes
1	GND	I	Ground	
2	GND	I	Ground	
3	VCC	I	Power Supply For Logic	
4	VCC	I	Power Supply For Logic	
5	GND	I	Ground	
6	R0	I	Red Data 0 [LSB]	
7	R1	I	Red Data 1	
8	R2	I	Red Data 2	
9	R3	I	Red Data 3	
10	R4	I	Red Data 4	
11	R5	I	Red Data 5 [MSB]	
12	GND	I	Ground	
13	G0	I	Green Data 0 [LSB]	
14	G1	I	Green Data 1	
15	G2	I	Green Data 2	
16	G3	I	Green Data 3	
17	G4	I	Green Data 4	
18	G5	I	Green Data 5 [MSB]	
19	GND	I	Ground	
20	B0	I	Blue Data 0 [LSB]	
21	B1	I	Blue Data 1	
22	B2	I	Blue Data 2	
23	B3	I	Blue Data 3	
24	B4	I	Blue Data 4	
25	B5	I	Blue Data 5 [MSB]	
26	GND	I	Ground	
27	CLK	I	Digital RGB Pixel Clock	
28	GND	I	Ground	
29	N.C.	-	No Connection	
30	HSYNC	I	Horizontal Sync Signal	
31	VSYNC	I	Vertical Sync Signal	
32	DE	I	Digital RGB Data Enable	
33	GND	I	Ground	
34	N.C.	-	No Connection	
35	N.C.	-	No Connection	
36	GND	I	Ground	
37	N.C.	-	No Connection	
38	N.C.	-	No Connection	
39	GND	I	Ground	
40	GND	I	Ground	

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5-1-2. Backlight FPC Pin Configuration

The matching connector model name is FH12-5S-1SH manufactured by HIROSE or equivalent.

Pin	Symbol	Description	Notes
1	Anode	Anode of LED chain	
2	Anode	Anode of LED chain	
3	N.C.	No Connection	
4	Cathode	Cathode of LED chain	
5	Cathode	Cathode of LED chain	

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5-2. Electrical Characteristics

@Ta=25℃, Aging time: Over 10 minutes

Parameter	Symbol	Min.	Typ.	Max.	Unit	Notes
Logic Supply Voltage	VCC	3.15	3.3	3.45	Vdc	
	I_{CC}	-	20	30	mA	1
Logic High Input Voltage	V_{IH}	0.8 x VCC	-	VCC	V	
Logic Low Input Voltage	V_{IL}	0	-	0.2 x VCC	V	2
Logic Input Current	I_{IH} / I_{IL}	-1	-	1	uA	

Notes:

1. Measure condition: VCC=3.3V, Black Patten

2. 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.

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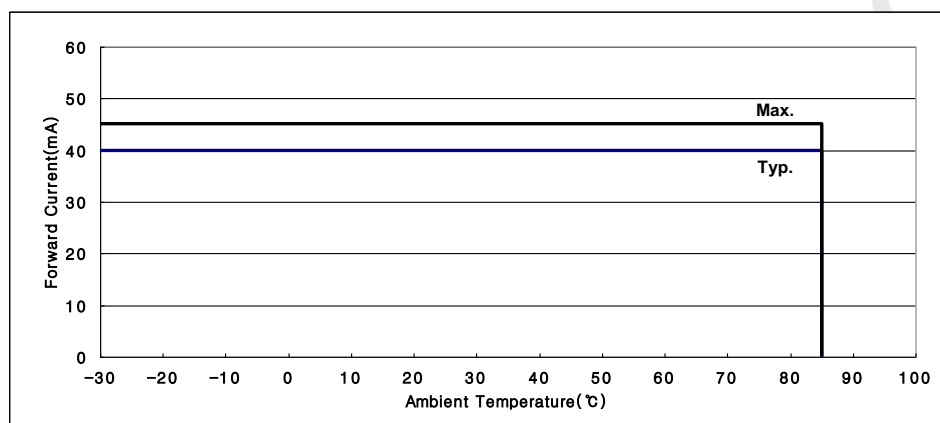## Product Specifications

5-3. LED Electrical Characteristics

Ta: 25℃, Aging time: 10 minutes

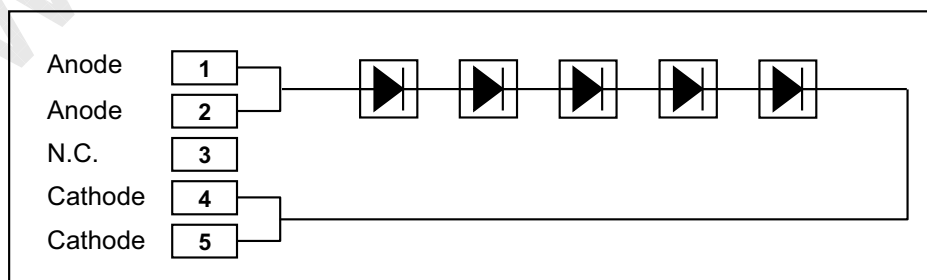| Parameter	Symbol	Values			Unit	Notes
		Min.	Typ.	Max.		
LED current per chain	I_{LED}	-	40	45	mA	1
LED voltage	V_{LED}	12.0	14.0	16.5	V	2
LED power	P_{LED}	-	0.56	0.75	W	
LED chain	-	-	1	-	-	3

Notes 1. LED derating curve.
LED should be turned off when Ambient temperature is over 85℃

Notes 2. LED forward voltage characteristics depend on temperature at typical LED current.

Temp.	Min.	Typ.	Max.	Unit
-30℃	13.9	15.5	17.1	V
+85℃	11.7	13.0	14.3	

Notes 3. LED chain diagram.

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5-4. Interface Timing Specification
5-4-1. Timing Characteristics of Driver IC input signals

Parameter	Symbol	Min.	Typ.	Max.	Unit	Notes
DCLK Frequency	f_{DCLK}	6.0	6.5	7.0	MHz	
DCLK Period	t_{CW}	143	154	167	ns	
DCLK High Period	t_{CWH}	50	-	-	ns	
DCLK Low Period	t_{CWL}	50	-	-	ns	
HSYNC Total Period	t_{HW}	378	390	406	t_{CW}	
Horizontal Back Porch	t_{HBP}	46	46	46	t_{CW}	
Horizontal Front Porch	t_{HFP}	8	-	-	t_{CW}	
HSYNC Low Period	t_{HWL}	4	-	-	t_{CW}	
VSYNC Frequency	f_{VS}	60	60	60	Hz	
VSYNC Total Period	t_{VW}	268	278	286	t_{HW}	Refer to 5-4-2.
Vertical Back Porch	t_{VBP}	16	16	16	t_{HW}	
Vertical Front Porch	t_{VFP}	10	-	-	t_{HW}	
VSYNC Low Period	t_{VWL}	2	-	-	t_{HW}	
Data Setup Time	t_{DS}	12	-	-	ns	
Data Hold Time	t_{DH}	20	-	-	ns	
HSYNC Setup Time	t_{HSYS}	20	-	-	ns	
HSYNC Hold Time	t_{HSYH}	20	-	-	ns	
VSYNC Setup Time	t_{VSYS}	20	-	-	ns	
VSYNC Hold Time	t_{VSYH}	20	-	-	ns	

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5-4-2. Digital RGB Timing Diagram
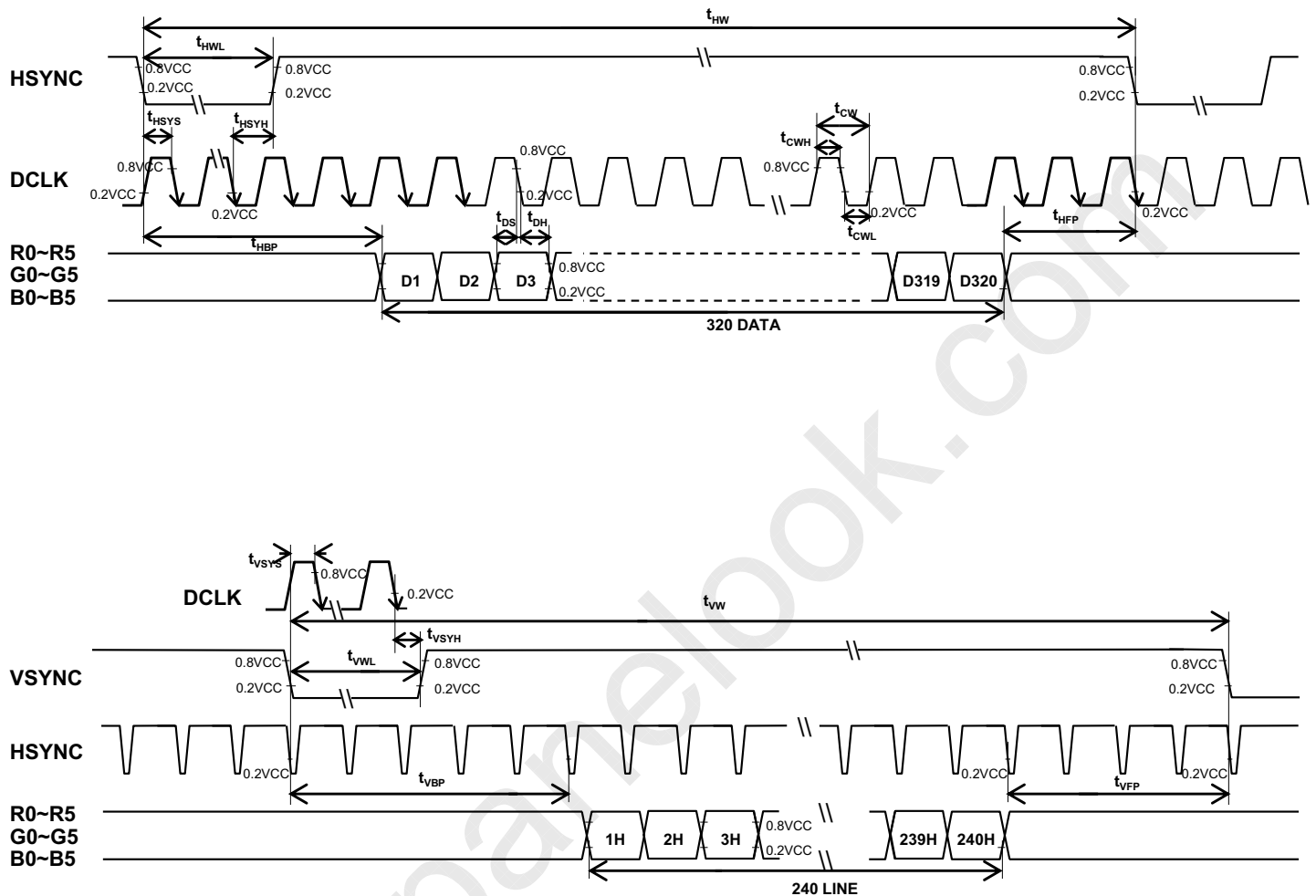
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5-4-3. Color Input Data Reference(Digital RGB)

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

COLOR DATA REFERENCE

Color		Input Color Data																		
		Red						Green						Blue					
		MSB					LSB	MSB					LSB	MSB					LSB
		R5	R4	R3	R2	R1	R0	G5	G4	G3	G2	G1	G0	B5	B4	B3	B2	B1	B0
Basic Colors	Black	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Red(63)	1	1	1	1	1	1	0	0	0	0	0	0	0	0	0	0	0	0
	Green(63)	0	0	0	0	0	0	1	1	1	1	1	1	0	0	0	0	0	0
	Blue(63)	0	0	0	0	0	0	0	0	0	0	0	0	1	1	1	1	1	1
	Cyan	0	0	0	0	0	0	1	1	1	1	1	1	1	1	1	1	1	1
	Magenta	1	1	1	1	1	1	0	0	0	0	0	0	1	1	1	1	1	1
	Yellow	1	1	1	1	1	1	1	1	1	1	1	1	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
Red	Red(00) Dark	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	1	0	0	0	0	0	0	0	0	0	0	0	0
	Red(02)	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0
	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:
	Red(61)	1	1	1	1	0	1	0	0	0	0	0	0	0	0	0	0	0	0
	Red(62)	1	1	1	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0
	Red(63) Bright	1	1	1	1	1	1	0	0	0	0	0	0	0	0	0	0	0	0
Green	Green(00)Dark	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	1	0	0	0	0	0	0
	Green(02)	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0
	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:
	Green(61)	0	0	0	0	0	0	1	1	1	1	0	1	0	0	0	0	0	0
	Green(62)	0	0	0	0	0	0	1	1	1	1	1	0	0	0	0	0	0	0
	Green(63)Bright	0	0	0	0	0	0	1	1	1	1	1	1	0	0	0	0	0	0
Blue	Blue(00) Dark	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	1
	Blue(02)	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0
	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:
	Blue(61)	0	0	0	0	0	0	0	0	0	0	0	0	1	1	1	1	0	1
	Blue(62)	0	0	0	0	0	0	0	0	0	0	0	0	1	1	1	1	1	0
	Blue(63) Bright	0	0	0	0	0	0	0	0	0	0	0	0	1	1	1	1	1	1

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5-5. Power Supply Sequence

For LCD's normal operation, it is recommended to keep below power supply sequence.
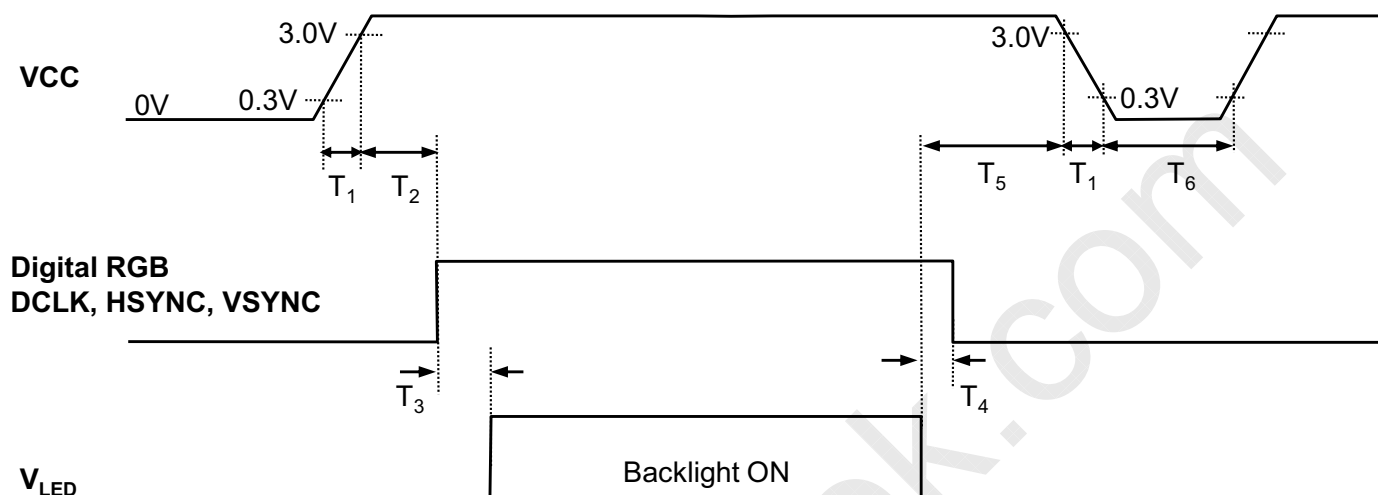
Parameter	Value			Units	Note
	Min.	Typ.	Max.		
T_1	0	-	10	ms	
T_2	1	-	50	ms	
T_3	800	-	-	ms	
T_4	0	-	-	ms	
T_5	0	-	-	ms	
T_6	800	-	-	ms	

Notes: If it is difficult to perform as our recommendation, customer should ask to LG Display.

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6. Electro-optical Characteristics

@T$_a$=25℃, Aging time: Over 10 minutes

Parameter		Symbol	Values			Units	Notes
			Min.	Typ.	Max.		
Contrast Ratio		CR	350	500	-	-	1
Surface Luminance, white		L$_{WH}$	500	625	-	cd/m2	2
Luminance Variation		δ_{WHITE}	80	85	-	%	3
Response Time	Rise Time	Tr$_R$	-	7	15	ms	4
	Decay Time	Tr$_D$	-	18	30	ms	
Color Coordinates	Red	R$_X$	0.535	0.585	0.635	-	2 (Reference Value)
		R$_Y$	0.313	0.363	0.413		
	Green	G$_X$	0.312	0.362	0.412		
		G$_Y$	0.513	0.563	0.613		
	Blue	B$_X$	0.110	0.160	0.210		
		B$_Y$	0.092	0.142	0.192		
	White	W$_X$	0.265	0.315	0.365		
		W$_Y$	0.290	0.340	0.390		
Viewing Angle	x axis, right ($\phi = 0°$)	Θr	65	70	-	degree	5
	x axis, left ($\phi = 180°$)	Θl	65	70	-		
	y axis, up ($\phi = 90°$)	Θu	55	60	-		
	y axis, down ($\phi = 270°$)	Θd	45	50	-		
Life Time		-	10,000	–	–	Hours	6

Notes:

1. Contrast Ratio (CR) is defined mathematically as

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

2. Surface luminance is measured at the center point(L1) of the LCD with all pixels displaying white at the distance of 500mm by PR-880. Color Coordinates are measured at the center point(L1) of the LCD with all pixels displaying red, green, blue and white at the distance of 500mm by PR-650. For more information, refer to the Fig. 1 and Fig. 2.

3. The variation in surface luminance. The panel total variation (δ_{WHITE}) is determined by measuring LN at each test position 1 through 9, and then dividing the maximum LN of 9 points luminance by minimum LN of 9 points luminance. For more information see the Fig. 1 and Fig. 2.
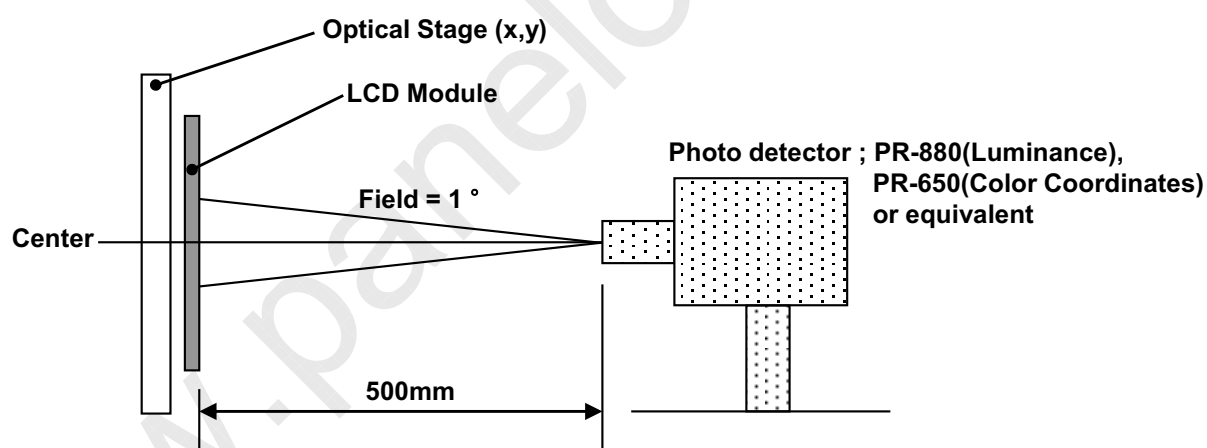
$$\delta_{WHITE} = \text{Minimum}(L1, L2, \ldots L9) / \text{Maximum}(L1, L2, \ldots L9) \times 100$$

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Notes:

4. Response time is the time required for the display to transition from white to black (Rise Time, Tr_R) and from black to white (Decay Time, Tr_D). For additional information see Fig. 3.

5. Viewing angle is the angle at which the contrast ratio is greater than 10. The angles are d e t e r m i n e d for the horizontal or x axis and the vertical or y axis with respect to the z axis which is normal to the LCD surface. For more information see Fig. 4.

6. "Life Time" is defined as the time the brightness decreases to 50% from initial brightness which is stabilized under continuous lighting condition, at ambient temperature 25℃.

Fig. 1 Optical Characteristic Measurement Equipment and Method

Optical Stage (x,y)

LCD Module

Photo detector ; PR-880(Luminance),
PR-650(Color Coordinates)
or equivalent

Field = 1 °

Center

500mm

Measuring Conditions ;
-Surroundings: Dark Room
-Temperature: Ta=25℃
-Input Video Signal: Digital RGB (18bits)
-Electrical parameters set typical values.
-Measured value at the center point of LCD panel after more than 10 minutes while
 backlight turning on.

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Fig. 2 Luminance

<measuring point for surface luminance & measuring point for luminance variation >

H,V: ACTIVE AREA
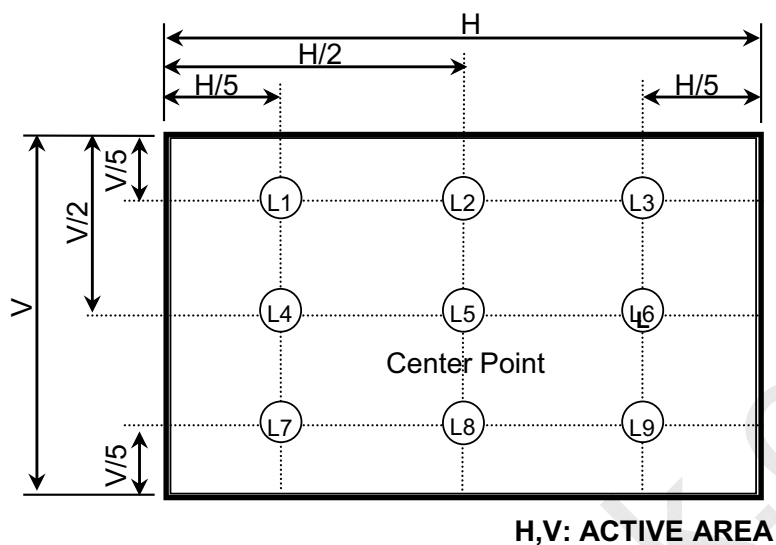
Fig. 3 Response Time

The response time is defined as the following figure and shall be measured by switching the input signal for "black" and "white".
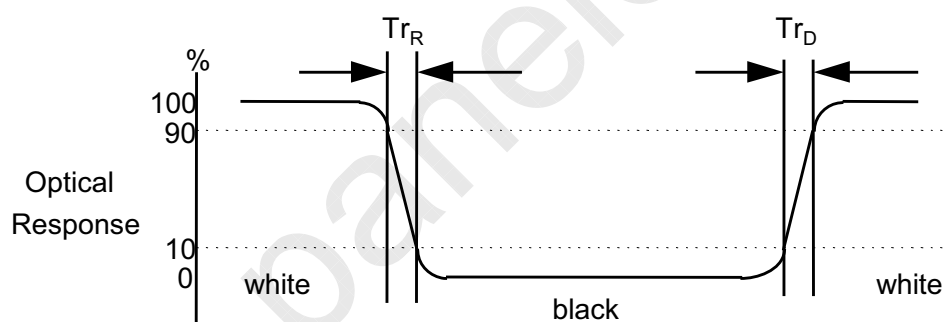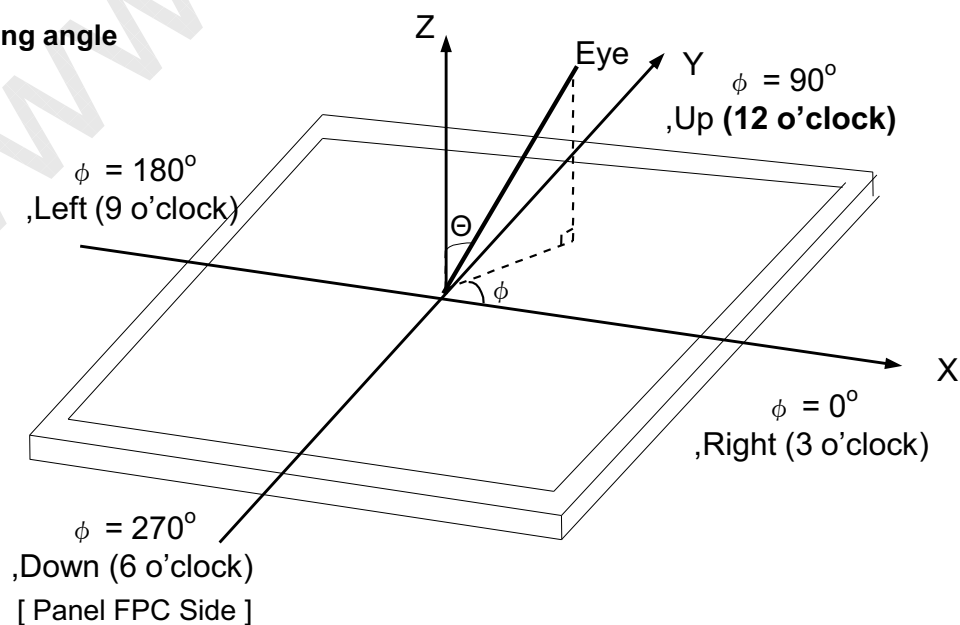

Fig. 4 Viewing angle

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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.

Outline Dimension	Horizontal	84.0 ± 0.2mm
	Vertical	67.0 ± 0.2mm
	Thickness	6.7 ± 0.3mm 9.9mm (Max., Part mounting area)
Bezel Area	Horizontal	72.8 ± 0.3mm
	Vertical	55.5 ± 0.3mm
Active Display Area	Horizontal	70.08mm
	Vertical	52.56mm
Weight	65g (Max.)	

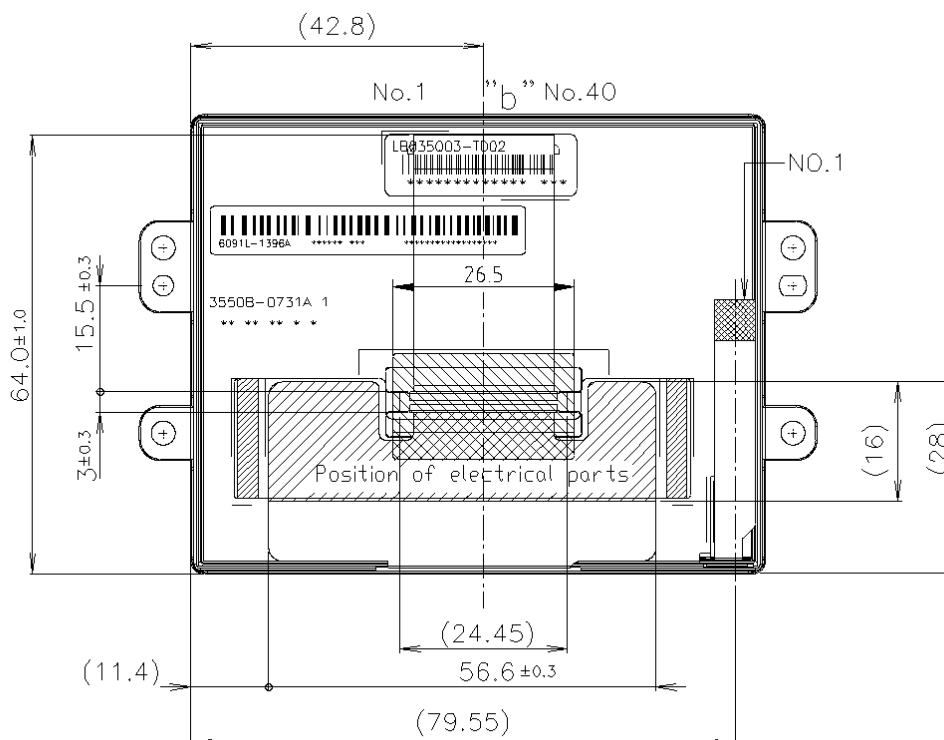## Product Specifications
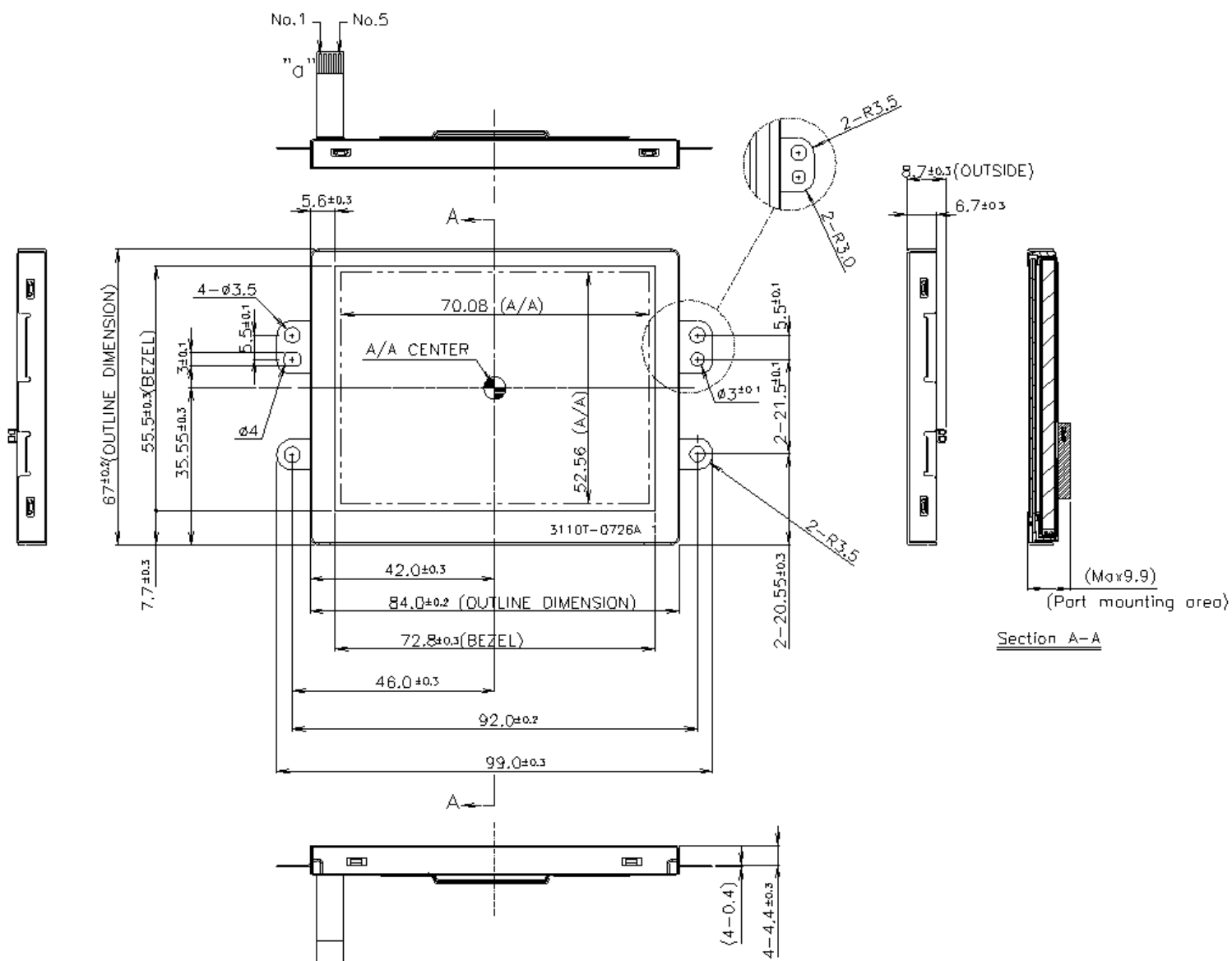
<FRONT VIEW>   Note) Unit:[mm], General tolerance: ± 0.3mm

(12 o'clock direction)

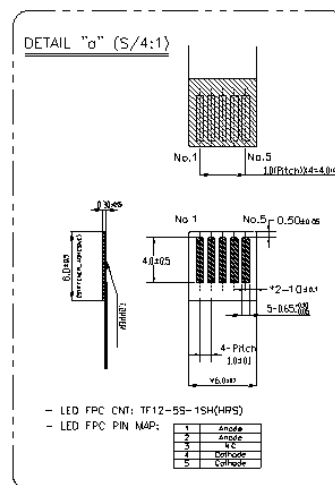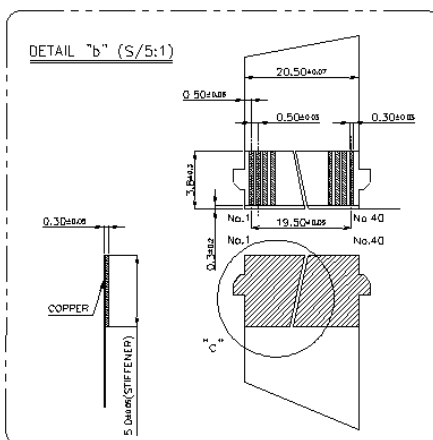## Product Specifications

<REAR VIEW>   Note) Unit:[mm], General tolerance: ± 0.3mm

(12 o'clock direction)
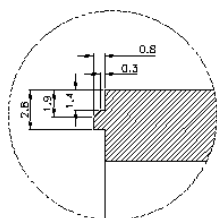
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8. Reliability Test

No.	Test Items	Test Condition	Notes
1	High Temperature Storage Test	Ta=85℃ 240h	
2	Low Temperature Storage Test	Ta=-40℃ 240h	
3	High Temperature Operation Test	Ta=85℃ 240h	
4	Low Temperature Operation Test	Ta=-30℃ 240h	
5	High Humidity Operation Test	Ta=65℃/90%RH 240h	
6	Humid Heat Cyclic Test	Ta=-10℃~65℃/80~96%RH 240h	
7	Thermal Shock Test	- 1cycle: Ta=-40℃(0.5h) ~ 85℃(0.5h) - 240Cycles	
8	Shock Test (non-operating)	- Half sine wave, 50G, 11ms, three times - One in each opposite direction of each perpendicular axis	
9	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	
10	Vibration Test Temperature Cycle	-10Hz to 50Hz, 1G, -20℃~60℃ - 8H×6Cycle	

• Ta: Ambient Temperature

Notes:

1. In the Reliability Test, Confirm performance after leaving in room temp(25℃)

2. In the standard condition, there shall be no practical problems that may affect the display function 24 hours later after reliability test.

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9. International Standards

9-1. Environment

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

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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	2001 2011	2002 2012	2003 2013	2004 2014	2005 2015	2006 2016	2007 2017	2008 2018	2009 2019	2010 2020
Mark	1	2	3	4	5	6	7	8	9	0

2. MONTH

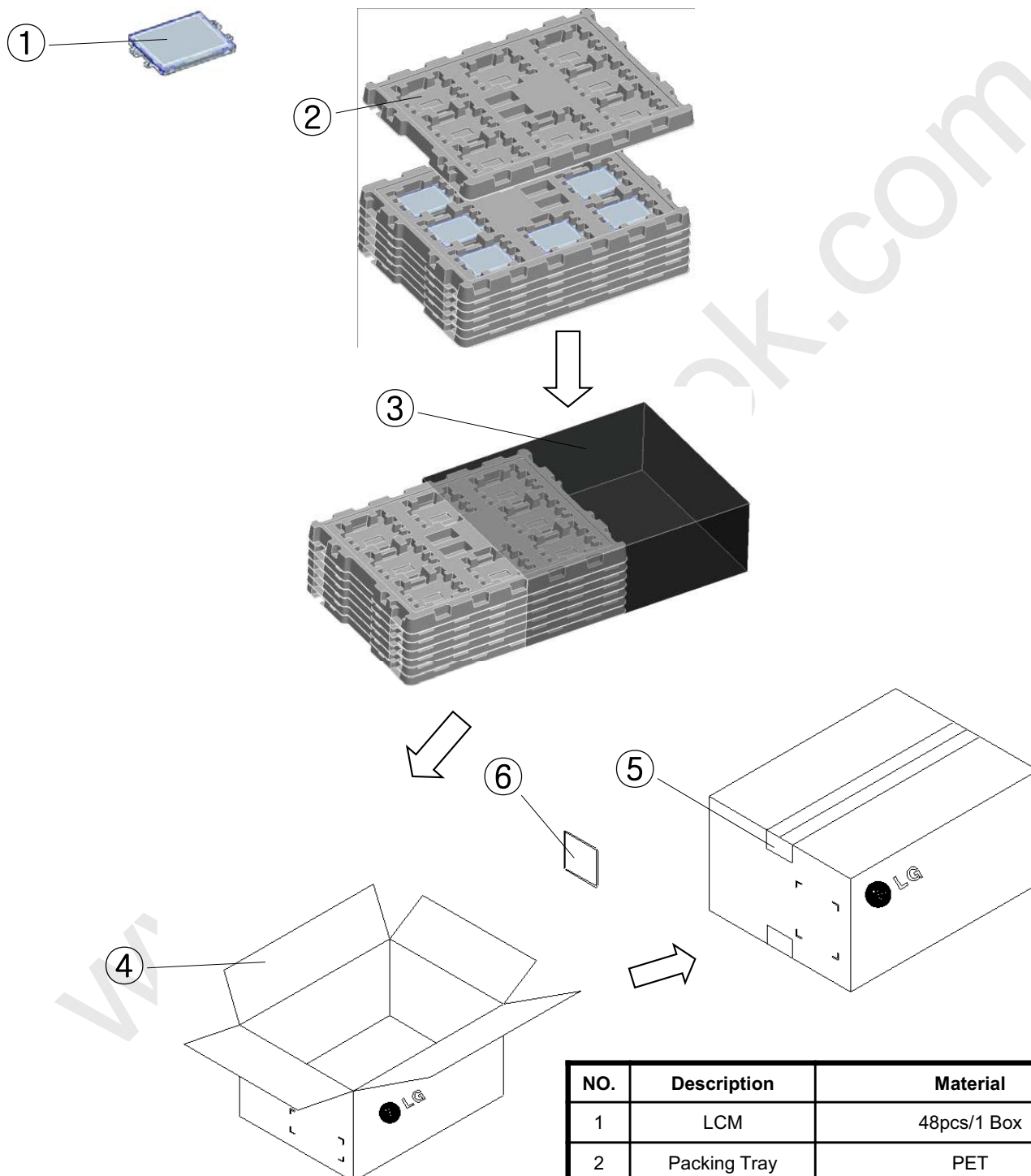| Month	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Mark	1	2	3	4	5	6	7	8	9	A	B	C

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 Specifications

10-2. Packing Form

a) Package quantity in one box : 48 pcs
b) Box Size : 478 x 365 x 162 (mm)

NO.	Description	Material
1	LCM	48pcs/1 Box
2	Packing Tray	PET
3	Bag	PE, 560X680
4	Carton Box	SWR4, 478X365X162
5	Tape	OPP 70MMx300m
6	Label	YUPO Paper 100x70

LG Display

Product Specifications

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 holes arranged in four corners or four sides.
(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 forces are 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 forces.
(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 a small amount of Ethanol.
(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) Response time depends on the temperature. (In lower temperature, it becomes longer.)
(2) Brightness depends on the temperature. (In higher temperature, it becomes lower.)
(3) Be careful for condensation at sudden temperature change. Condensation makes damage to polarizer or electrically 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) 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 Specifications

11-3. ELECTROSTATIC DISCHARGE CONTROL

Since a module 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.

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.