

Product Specification

**SPECIFICATION
FOR
APPROVAL**

- (●) Preliminary Specification
- () Final Specification

Title	4.0" (320 X RGB X 240) TFT- LCD
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BUYER	
MODEL	

SUPPLIER	LG.Philips LCD CO.,Ltd.
MODEL	LB040Q03
SUFFIX	TD02

SIGNATURE	DATE
/	_____
/	_____
/	_____

APPROVED BY	DATE
C. S. KYEONG /G. Manager	_____
REVIEWED BY	
C. K. Shin / Manager	_____
PREPARED BY	
T. W. Jung / Engineer	_____

**Product Engineering Dept.
LG. Philips LCD Co., Ltd**

Product Specification**Contents**

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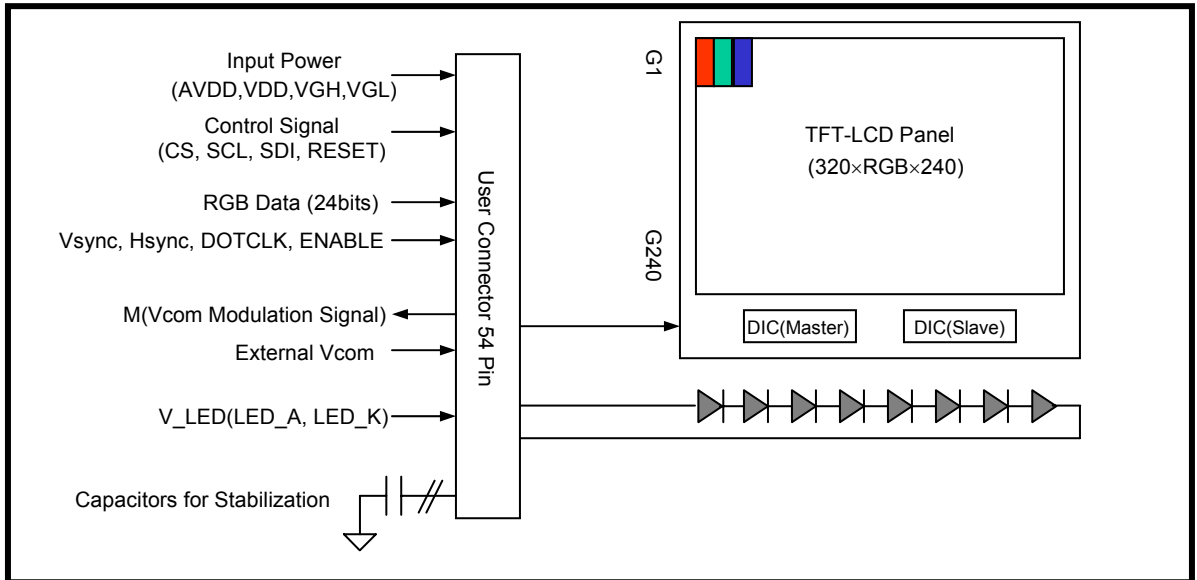
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1. General Description

1-1. Description

The LB040Q03 is a Color Active Matrix Liquid Crystal Display with a white LED backlight assembly. The matrix employs a-Si Thin Film Transistor as the active element. It is a transmissive type display operating in the normally white mode. This module is a diagonal 4.0 inch with the Landscape typed QVGA resolution.

The LB040Q03 is intended to support displays. [VoIP(Voice over Internet Protocol) Phone, PMP(Portable Multimedia Player) and others]



1-2. Features

PARAMETER	SPECIFICATION	REMARK
Active Screen Size	4 inches	Diagonal
Outline Dimension	96.0[H] x 75.6[V] x 3.65[D]	[mm]
Active Area	81.6[H] x 61.2[V]	[mm]
Number of dots	320[H] x RGB x 240[V]	-
Dot Pitch	0.255 x 0.255	[mm]
Display Mode	TN / Transmissive / Normally White	-
Viewing Direction	6 o'clock	12 o'clock (good viewing)
Color Filter Array	RGB Vertical Stripe	-
Signal Interface	Digital RGB + SPI Interface	-
Weight	50g (Typ.)	-
Backlight	8 LEDs	Serial Type

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2. Interface Connections

This LCD employs one interface connection for the operation of module and LED B/L. The pin configuration for the connector is shown in the table below.

(LCD Connector: FPC(54Pin 0.5mm pitch), Mating Connector: LD09T4-54NB(Sumiko) or equivalent

Pin	Symbol	Description	I/O	Remark
1	LED_K	LED_Cathode	I	
2	LED_K	LED_Cathode	I	
3	LED_A	LED_Anode	I	
4	LED_A	LED_Anode	I	
5	C_VCL_S	Slave IC VCL Stabilization Cap	O	
6	V_VGOFF_S	Slave IC VGOFF Stabilization Cap	O	
7	M	Vcom Modulation Signal	O	From Master IC
8	RESET	Reset	I	
9	CS	Chip Selection	I	See P.15
10	SCL	Serial Clock Line	I	See P.15
11	SDI	Serial Data Input	I	See P.15
12	PD0	Blue Data [LSB]	I	
13	PD1	Blue Data	I	
14	PD2	Blue Data	I	
15	PD3	Blue Data	I	
16	PD4	Blue Data	I	
17	PD5	Blue Data	I	
18	PD6	Blue Data	I	
19	PD7	Blue Data [MSB]	I	
20	PD8	Green Data [LSB]	I	
21	PD9	Green Data	I	
22	PD10	Green Data	I	
23	PD11	Green Data	I	
24	PD12	Green Data	I	
25	PD13	Green Data	I	
26	PD14	Green Data	I	
27	PD15	Green Data [MSB]	I	
28	PD16	Red Data [LSB]	I	
29	PD17	Red Data	I	
30	PD18	Red Data	I	
31	PD19	Red Data	I	
32	PD20	Red Data	I	
33	PD21	Red Data	I	

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Pin	Symbol	Description	I/O	Remark
34	PD22	Red Data	I	
35	PD23	Red Data [MSB]	I	
36	HSYNC	Horizontal Sync Signal	I	See P.14
37	VSYNC	Vertical Sync Signal	I	See P.14
38	DOTCLK	Data Clock	I	See P.14
39	AVDD	Analog Voltage	I	
40	AVDD	Analog Voltage	I	
41	VDD	Digital Voltage	I	
42	VDD	Digital Voltage	I	
43	C_RVDD_S	Slave IC RVDD Stabilization Cap	O	
44	VGL	Vgoff Voltage	I	
45	VGL	Vgoff Voltage	I	
46	C_VCL_M	Master IC VCL Stabilization Cap	O	
47	VGH	Vgon Voltage	I	
48	V_GOFF_M	Master IC V_GOFF Stabilization Cap	O	
49	C_RVDD_M	Master IC RVDD Stabilization Cap	O	
50	VCOM	Common Electrode Signal	I	
51	VCOM	Common Electrode Signal	I	
52	ENABLE	Data Enable	I	
53	GND	Ground	I	
54	GND	Ground	I	

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3. Absolute Maximum Ratings

If used the beyond absolute maximum ratings, this device can permanently be damaged.
 It is strongly recommended to use this device at a condition for normal operation.

PARAMETER	SYMBOL	CONDITION	MIN.	MAX.	UNIT	REMARK
Digital Supply Voltage	VDD	T _a =25℃	-0.3	5.0	V	-
Analog Supply Voltage	AVDD	T _a =25℃	-0.3	7.0	V	-
Power Supply for Gate Level Shifter	V _{GH} -V _{GL}	T _a =25℃	-	33.0	V	-
LED Forward Current	I _f	T _a =25℃	-	25	mA	[Note 3-1]
Operating Temperature	T _{OP}	-	-20	70	℃	[Note 3-2]
Storage Temperature	T _{ST}	-	-30	80	℃	[Note 3-2]
Humidity	H _{OP}	-	5	95	%RH	[Note 3-2]

[Note 3-1] Applies for each LED individually

[Note 3-2] Humidity: 95% RH Max, no condensation > 40 ℃

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4. Electrical Characteristics

4-1. TFT LCD Module

$T_a = 25^\circ C$

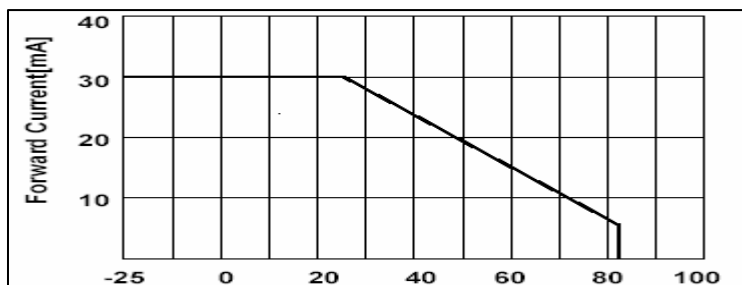
PARAMETER	SYMBOL	MIN.	TYP.	MAX.	UNIT	REMARK
Digital Supply Voltage	VDD	3.0	3.3	3.6	V	
Analog Supply Voltage	AVDD	4.7	4.8	4.9	V	
Gate On Voltage	V_{GH}	17.0	18.0	19.0	V	
Gate Off Voltage	V_{GL}	-10.5	-9.5	-8.5	V	
Frame Frequency	f_{FRAME}	60	70	75	Hz	
Dot Clock	DOTCLK	-	-	10	MHz	
Serial Clock	SCL	-	-	10	MHz	
Logic Input Voltage	V_{IH}	0.8*VDD	-	VDD	V	
	V_{IL}	0	-	0.2*VDD	V	
Logic Output Voltage	V_{OH}	VDD-0.5	-	VDD	V	
	V_{OL}	0	-	0.5	V	
Input Leakage Current	I_{IL}	-1.0	-	3.0	uA	
Output Leakage Current	I_{OL}	3.0	-	4.5	uA	

4-2. Backlight Unit

$T_a = 25^\circ C$

PARAMETER	SYMBOL	MIN.	TYP.	MAX.	UNIT	REMARK
LED forward Current	I_f	-	20	-	mA	[Note4-1]
Power Consumption	P_{BL}	-	530	-	mW	

[Note4-1] The permissible forward current of LED vary with environmental temperature.



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5. Optical Characteristics

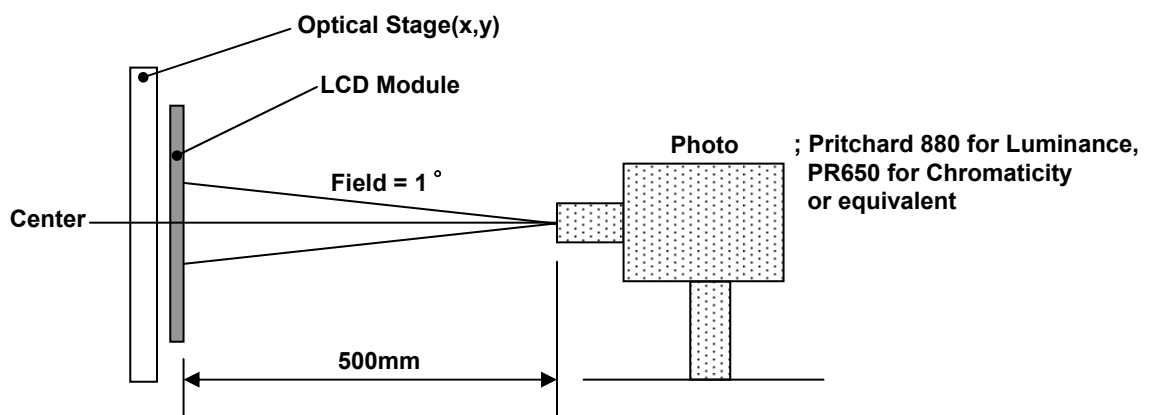
5-1. TFT LCD Module

$T_a = 25^\circ C$

PARAMETER	SYMBOL	CONDITION	MIN.	TYP.	MAX.	UNIT	REMARK	
Luminance	Y	$I_{BL} = 20mA$	300	400	-	cd/m ²	[Note5-1]	
Contrast Ratio	CR	Center Point	300	450	-	-	[Note5-2]	
White color Chromaticity	Wx	$I_{BL} = 20mA$	0.275	0.325	0.375	-	[Note5-1] PR-650	
	Wy		0.300	0.350	0.400	-		
Viewing Angle	Hor.	CR > 10	θ_L	60	65	-	Degrees	[Note5-2] [Note5-3] PR-880
			θ_R	60	65	-		
	Ver.		θ_U	45	50	-		
			θ_D	55	60	-		
Response Time	Rising	$T_r + T_f$	$\theta = 0^\circ$	-	30	40	msec	[Note5-4] PR-880
	Falling							
Luminance Uniformity	U	$I_{BL} = 20mA$	-	1.20	1.40	-	[Note5-5]	

- Measurement condition : Refer to the below "Test Equipment Set Up" and next two pages

[Test Equipment Set Up]



- Measuring Condition ;
 - Measuring surroundings : Dark Room
 - Measuring temperature : $T_a = 25^\circ C$
 - Adjust operating voltage to get optimum contrast at the center of the display.
 - Measured value at the center point of LCD panel after more than 10 minutes while backlight turning on.

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[Note 5-1]

Measured on the center area of the panel by PHOTO RESEARCH photometer PR-880&PR650 or Equivalent

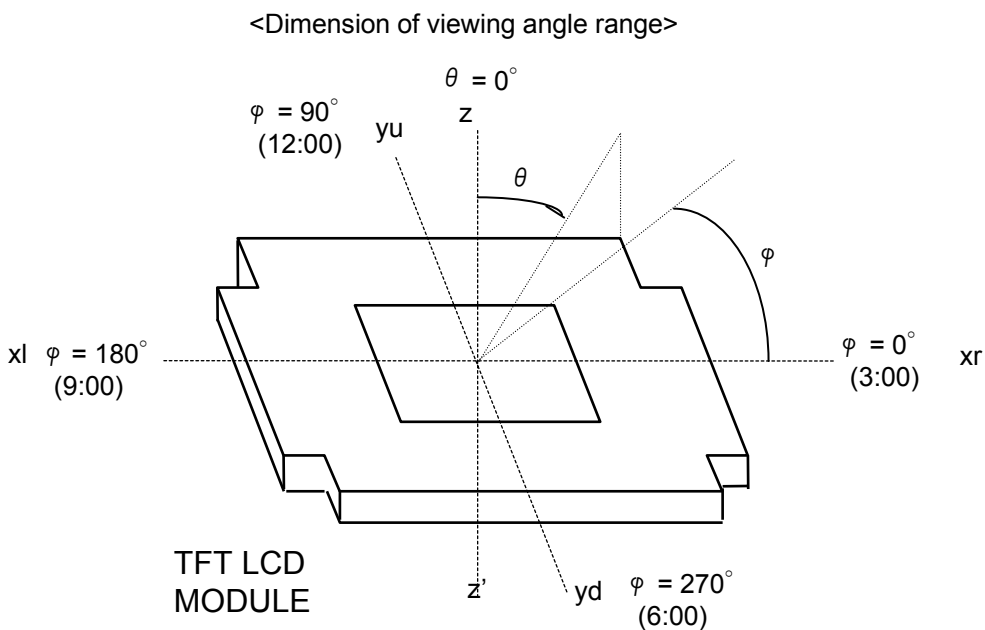
[Note 5-2]

Contrast ratio is defined as follows ;

$$\text{Contrast Ratio(CR)} = \frac{\text{Photo detector output with LCD being "white"}}{\text{Photo detector output with LCD being "black"}}$$

[Note 5-3]

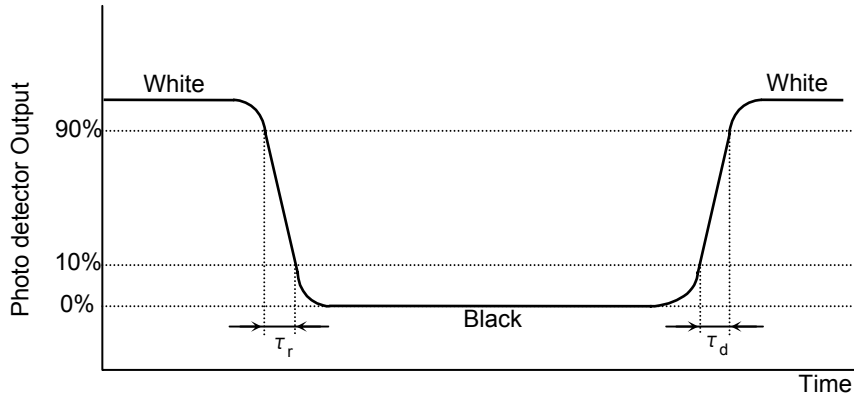
Viewing angle range is defined as follows [PR-880];



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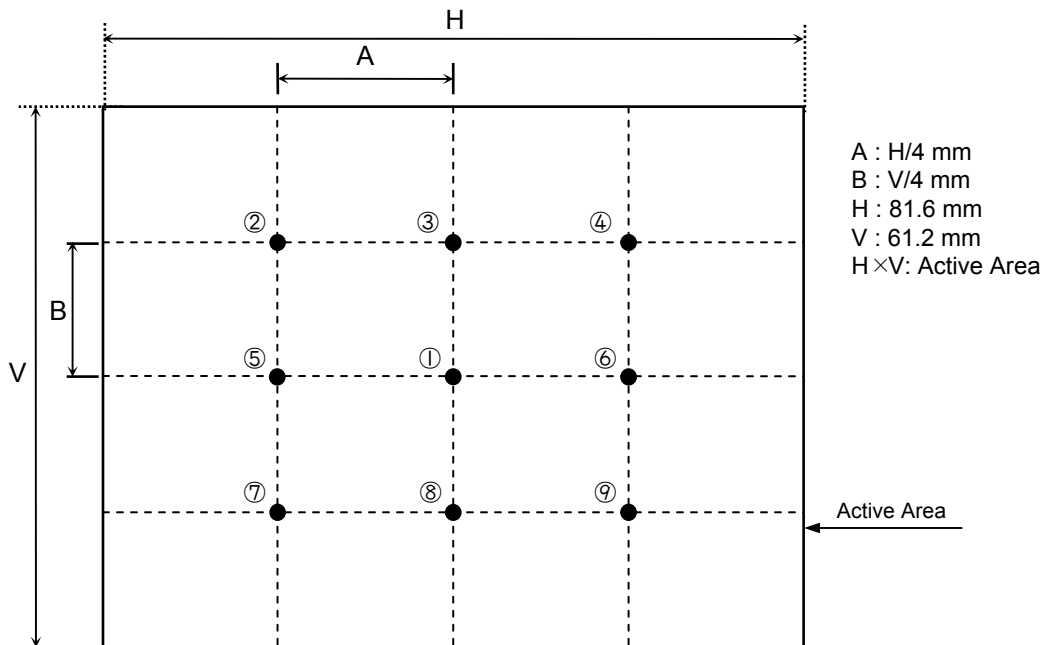
[Note 5-4]

Response time is obtained by measuring the transition time of photo detector output, when input signals are applied so as to make the area "black" to and from "white".



[Note 5-5]

Luminance Uniformity = Maximum of 9points (①~⑨) / Minimum of 9points (①~⑨)
Luminance Uniformity(%) = Minimum of 9points (①~⑨) / Maximum of 9points (①~⑨) x 100



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6. Mechanical Characteristics

PARAMETER	SPECIFICATION		UNIT	REMARK
Outline Dimension	Width	96.0	mm	공차 (±0.3)
	Height	75.6	mm	
	Depth	3.65	mm	
Bezel Area	Width	88.0	mm	
	Height	64.6	mm	
Active Display Area	Width	81.6	mm	
	Height	61.2	mm	
Weight	50 (Typ.)		g	
Surface Treatment	Anti-glare Treatment			

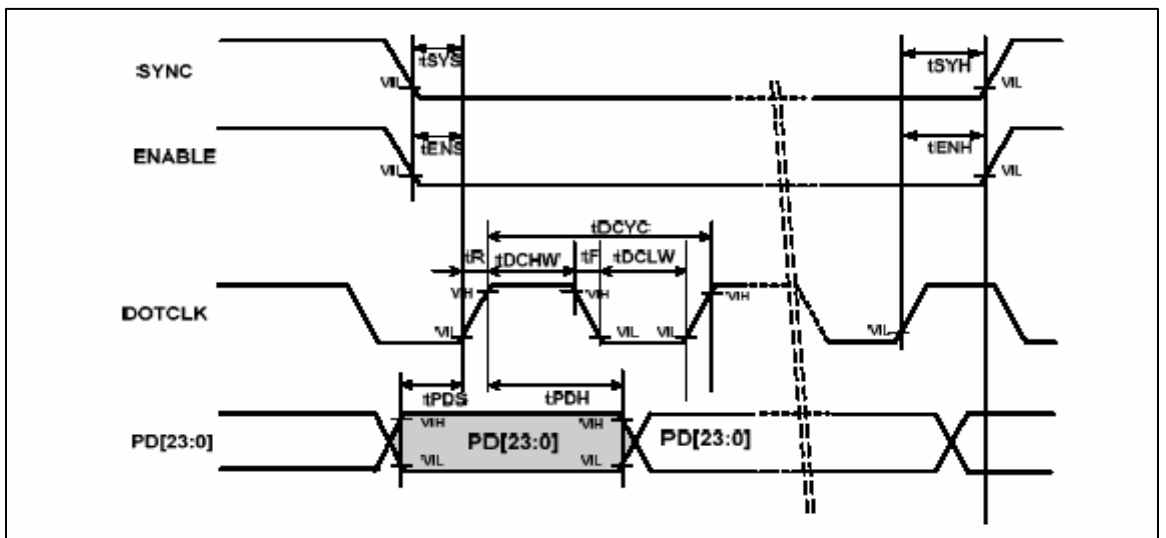
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7. Operation Specifications

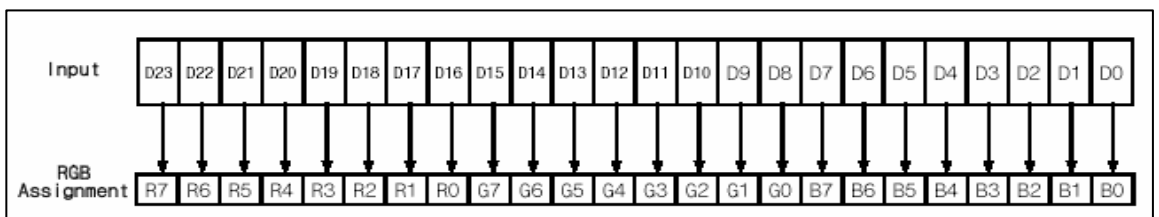
7-1. RGB Data Interface

7-1-1. RGB Data Interface Timing Characteristics

PARAMETER	SYMBOL	24bit Interface		8 bit Interface		Unit
		Min.	Max.	Min.	Max.	
DOTCLK Cycle Time	tDCYC	100	-	30	-	ns
DOTCLK Rise/Fall Time	tR, tF	-	2	-	2	
DOTCLK Pulse Width High	tDCHW	50	-	15	-	
DOTCLK Pulse Width Low	tDCLW	50	-	15	-	
Sync Setup Time	tSYS	30	-	10	-	
Sync Hold Time	tSYH	30	-	10	-	
ENABLE Setup Time	tENS	30	-	10	-	
ENABLE Hold Time	tENH	30	-	10	-	
PD Data Setup Time	tPDS	30	-	5	-	
PD Data Hold Time	tPDH	30	-	5	-	



7-1-2. Data Format for 24 bit RGB Data Interface

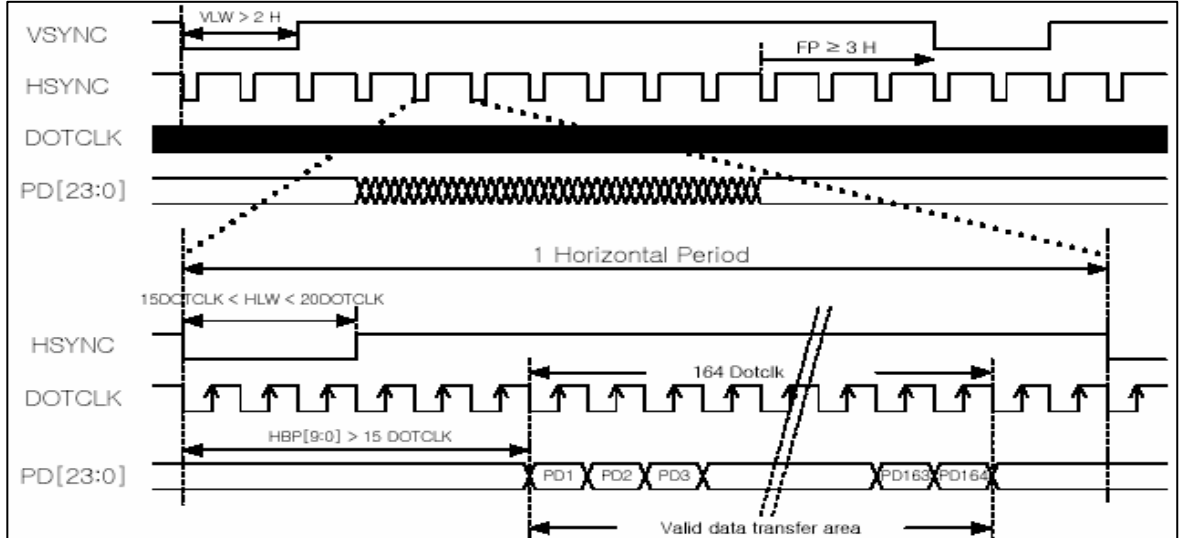


[Note] 8-Bit RGB Interface can be used by setting IM Pin to '1'.
and data for display is transferred through 8-bit data bus (upper 8 bit : PD23 to PD6)

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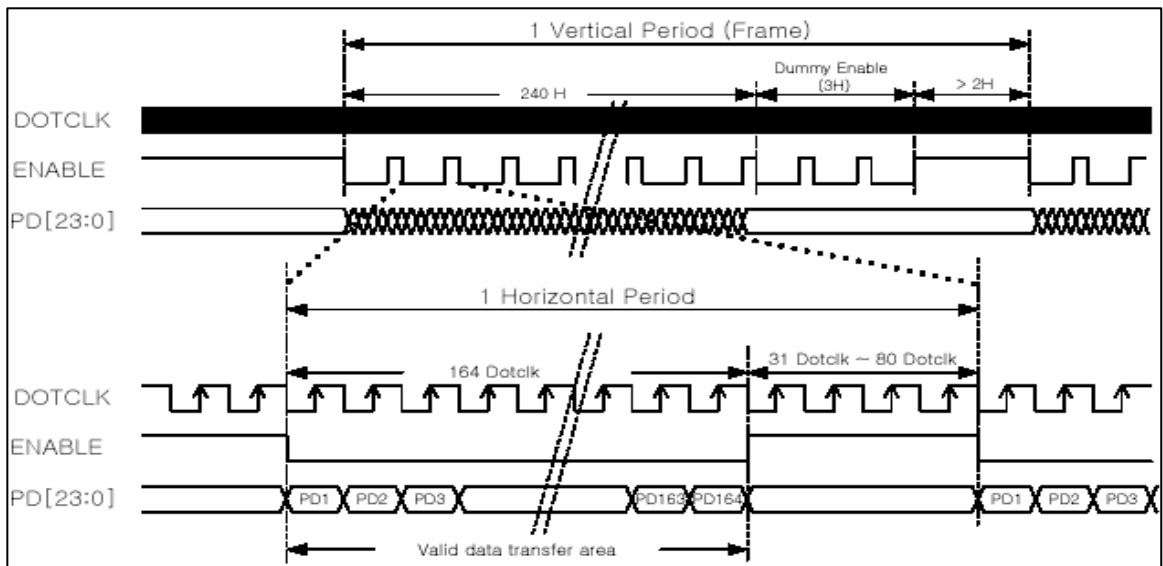
7-1-3. 24 Bit RGB Interface Timing

7-1-3-1. Sync Mode



[Note] The rising edge of DOTCLK is used to fetch display data PD bus.
The Delay amount of the source output must be larger than the Hsync Low Pulse Width.

7-1-3-2. DE Mode



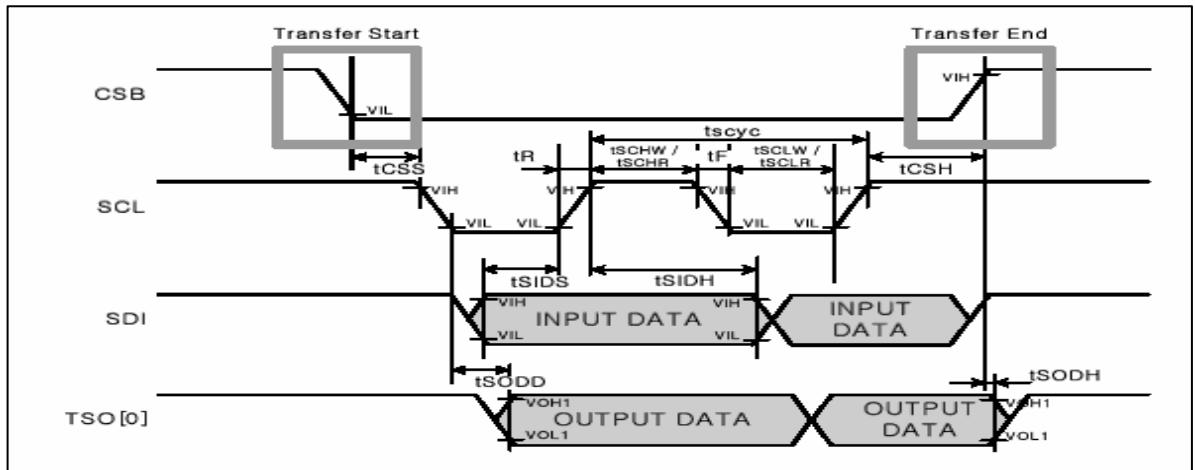
[Note] The rising edge of DOTCLK is used to fetch display data PD bus.

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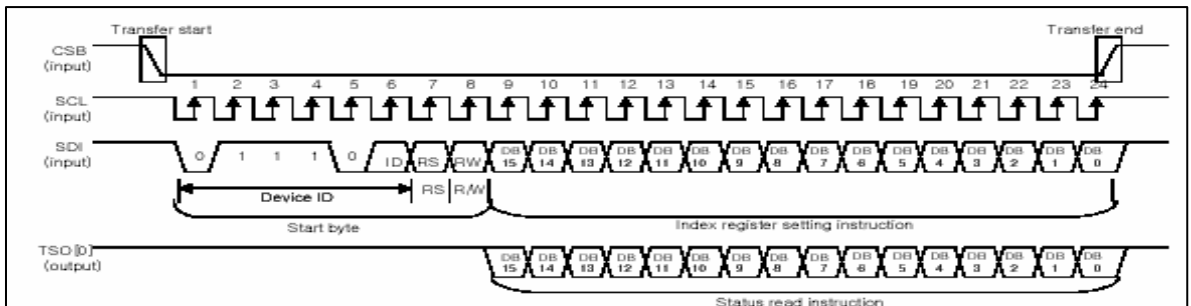
7-2. Serial Peripheral Interface

7-2-1. Clock Synchronized Serial Mode Characteristics

PARAMETER	SYMBOL	MIN.	MAX.	UNIT
Serial Clock Cycle Time	Tscyc	100	-	ns
Serial Clock Rise/Fall Time	tR,tF	-	2	
Pulse Width High For Write	tSCHW	30	-	
Pulse Width High For Read	tSCHR	50	-	
Pulse Width Low For Write	tSCLW	30	-	
Pulse Width Low For Read	tSCLR	50	-	
Chip Select Setup Time	tCSS	20	-	
Chip Select Hold Time	tCSH	50	-	
Serial Input Data Setup Time	tSIDS	30	-	
Serial Input Data Hold Time	tSIDH	30	-	
Serial Output Data Delay Time	tSODD	-	100	
Serial Output Data Hold Time	tSODH	5	-	



7-2-2. Clock Synchronized Serial Mode Characteristics

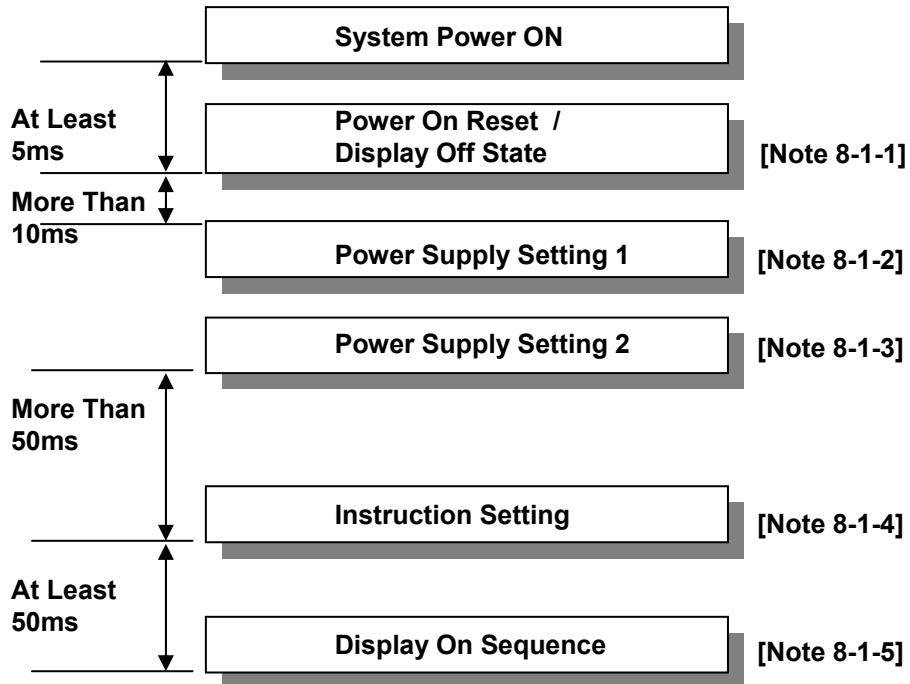


[Note] ID pin = "0" On FPC
RS="0" [Index], RS="1" [Instruction]

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8. Power On/Off Sequence

8-1. Power On Sequence



[Note 8-1-1] R0A [0x0000h] GON=0, POC=0
R0A [0x2000h] GXEN=1

[Note 8-1-2] R0A [0x6000h] EXM=1
R0B [0x0000h] VCOMG=0, VDV, VCM

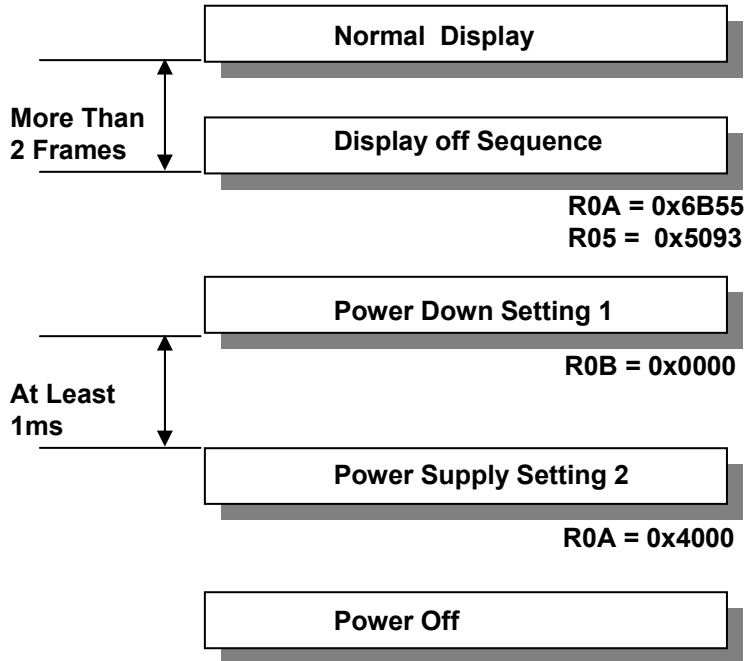
[Note 8-1-3] R0A [0x6155h] HSM / SAP / AP

[Note 8-1-4] R01 [0x609Dh] R10 [0x0201h] R14 [0x0707h]
R02 [0x0204h] R11 [0x0003h] R15 [0x0003h]
R03 [0x0100h] R12 [0x100Eh] R16 [0x0407h]
R04 [0x4008h] R13 [0x1D06h] R17 [0x0006h]
R05 [0x4013h] R18 [0x0007h]
R06 [0x0000h] R19 [0x0300h]
R07 [0x0023h]
R08 [0x0021h]
R09 [0x0800h]

[Note 8-1-5] R0A [0x6B55h] GON=1
R05 [0x5093h] POC=1

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8-2. Power Off Sequence



[Note] The reset low pulse width should be kept for the stable operation of the driver.
(More than 5ms)

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9. Reliability Test

NO	TEST ITEMS	CONDITION	REMARK
1	High Temperature Storage Test	Ta = 80℃ 240h	-
2	Low Temperature Storage Test	Ta = -30℃ 240h	-
3	High Temperature Operation Test	Ta = 70℃ 240h	-
4	Low Temperature Operation Test	Ta = -20℃ 240h	-
5	High Temperature and High Humidity Operation Test	Ta = 60℃ 90%RH 240h	-
6	Shock Test (operating)	Operation, 180G, 2msec, Half Sine ±X, ±Y, ±Z Per 1time	-
7	Vibration Test (operating)	Random Vibration 50~200Hz, 2.0G X/Y/Z direction, Per 1Hour	-
8	Thermal Shock Test	-30℃ (0.5h) ~ 70℃ (0.5h) / 100 cycles	-

[Note]

T_a = Ambient Temperature

In the standard condition, there shall be no practical problems that may affect the display function.

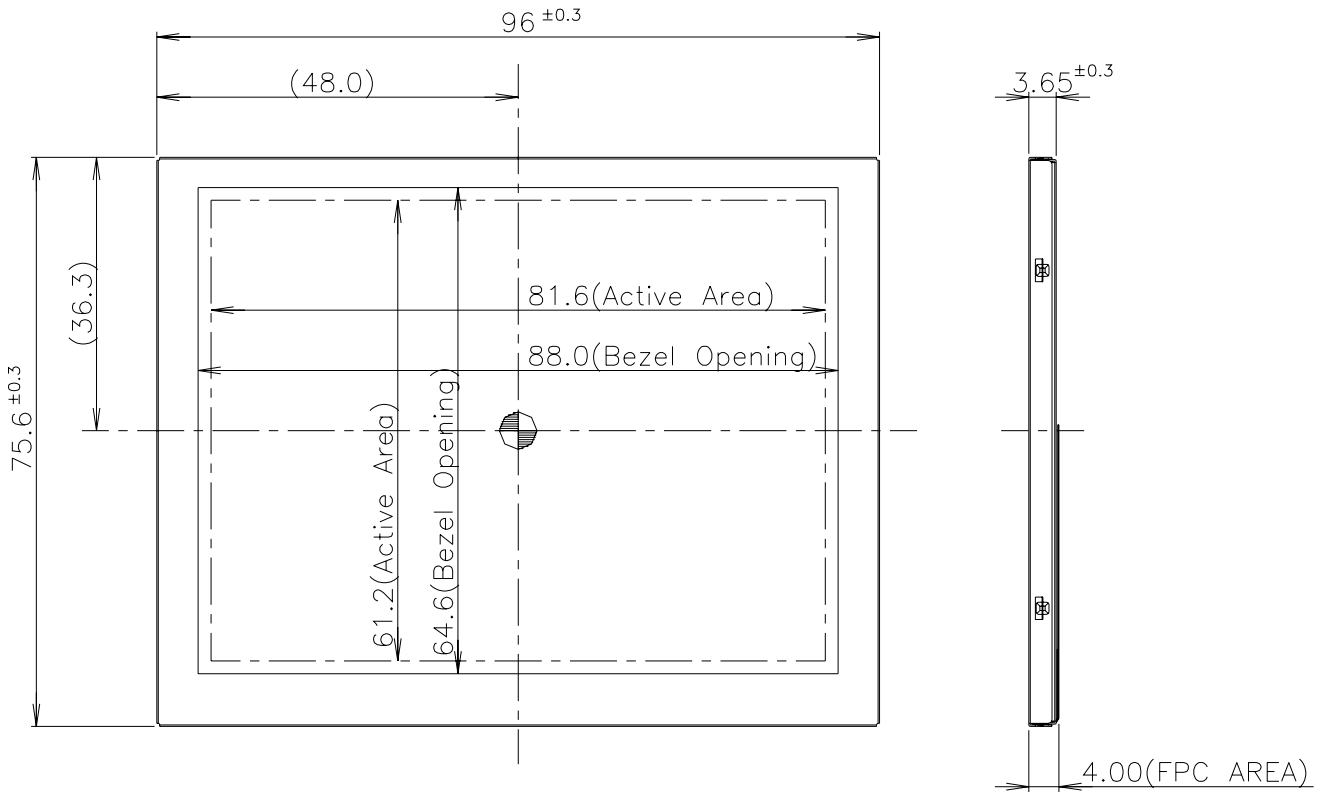
Result Evaluation Criteria

TFT- LCD Module should be at room temperature for 2 hours when the display quality test is over. There should be no particular change which might affect the practical display function and the display quality test should be conducted under normal operating condition.

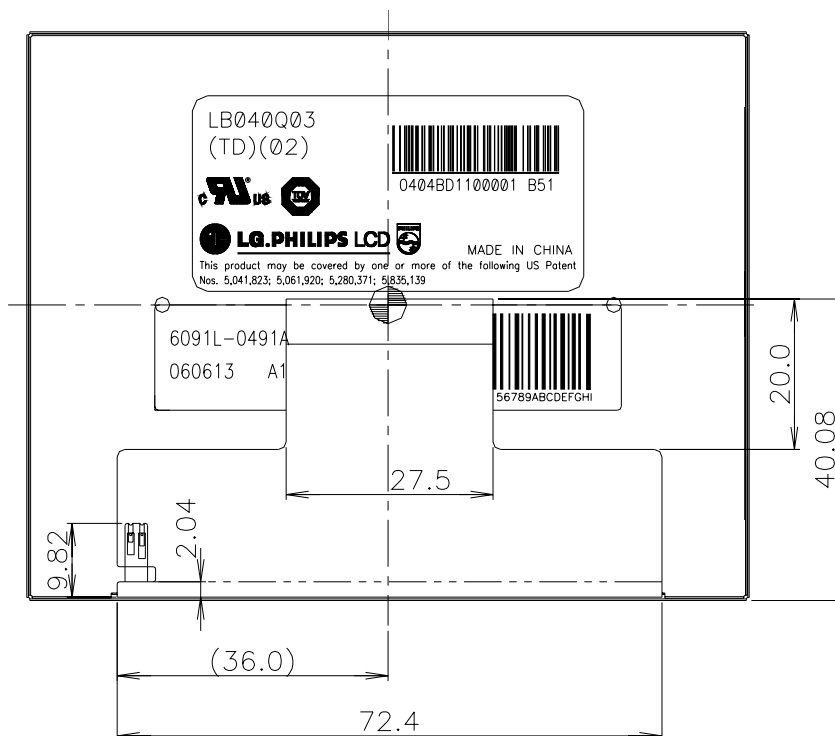
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10. Outline Dimension

10-1. Front View

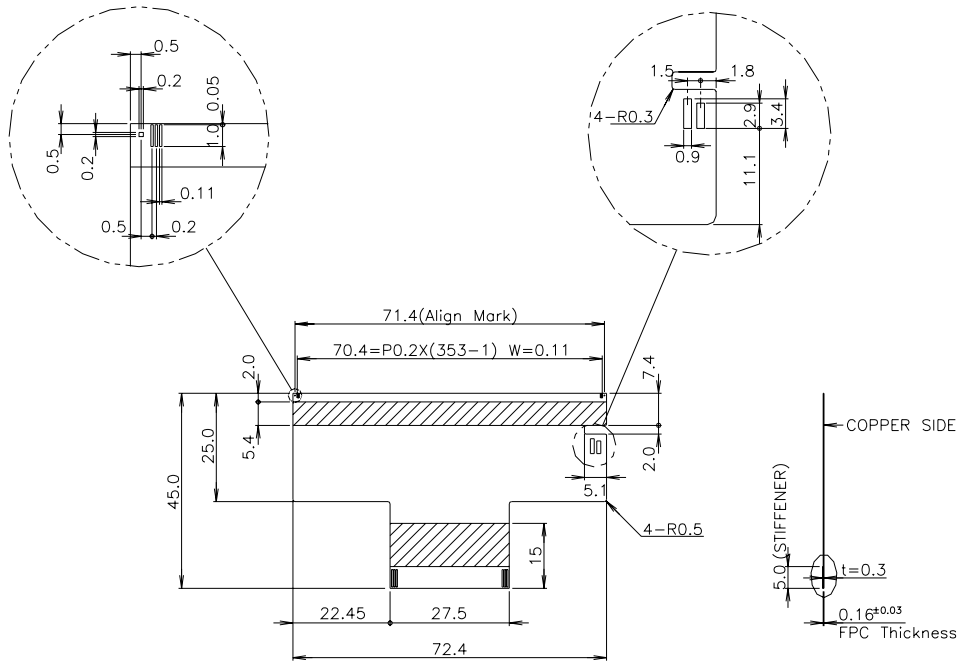


10-2. Rear View

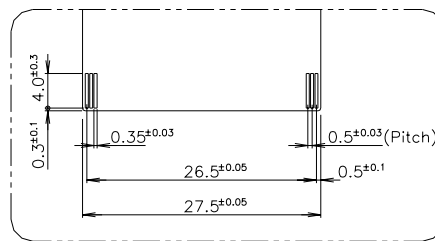


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10-3. FPC (Front View)



Scale: 2/1

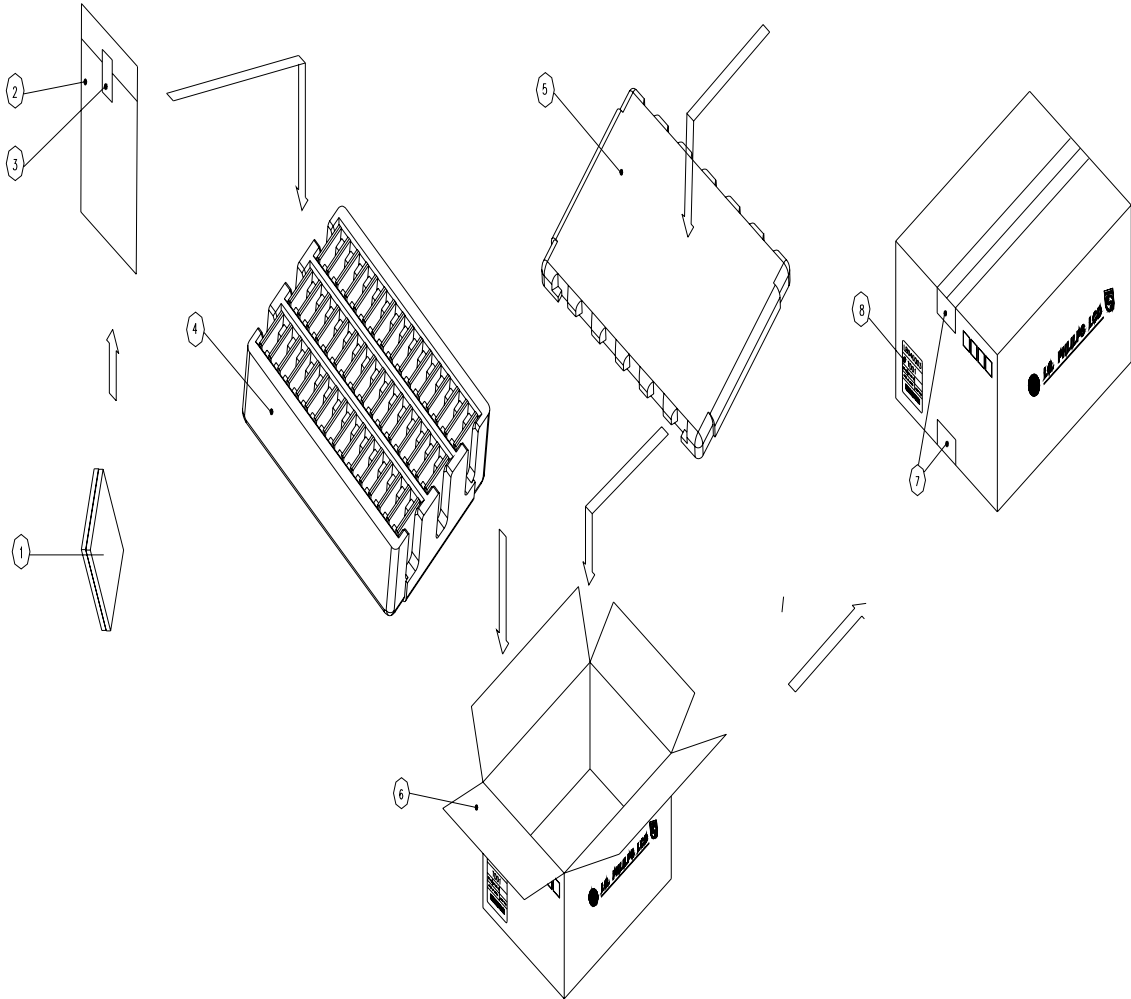


 COVERLAY OPEN AREA

[Note] No SMD on FPC.

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11. Packing



No	Description
①	LCD Module
②	Bag
③	Tape
④	Packing , Bottom
⑤	Packing, Top
⑥	Box
⑦	Tape
⑧	Label

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12. Marking & Others

12-1. Designation of Lot Mark

12-1-1 Lot Mark

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

A,B,C : SIZE (INCH)
E : MONTH
G : ASSEMBLY CODE

D : YEAR
F : FACTORY CODE
H ~ M : SERIAL NO.

[Note]

1. YEAR

Year	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010
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

3. FACTORY CODE

Factory Code	LPL Gumi	LPL Nanjing	HEESUNG
Mark	K	C	D

4. SERIAL NO.

Mark	100001~199999, 200001~299999, 300001~399999,, A00001~A99999,, Z00001~Z99999
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12-1-2 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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13. Precautions

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

13-1. Mounting Precautions

- <1> You may mount a module using four corner 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 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 and toluene 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 open the case because inside circuits do not have sufficient strength.
- <9> The metal case of a module should be contacted to electrical ground of your system.

13-2. Operating Precautions

- <1> The spike noise causes the disoperation 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 lower temperature, it becomes lower.)
And in lower temperature, response time(required time that brightness is stable after turned on) becomes longer.
- <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.

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13-3. 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.

13-4. Precautions For Strong Light Exposure

Strong light exposure causes degradation of polarizer and color filter.

13-5. 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.
- <3> The warranty for storage of the color TFT-LCD module shall be in compliance with the Incoming Inspection standard.

13-6. Handling Precautions For Protection Film

- <1> 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> The protection film is attached to the polarizer with a small amount of glue. If some stress is applied to rub the protection film against the polarizer during the time you peel off the film, the glue is apt to remain on the polarizer.
Please carefully peel off the protection film without rubbing it against the polarizer.
- <3> 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 polarizer after the protection film is peeled off.
- <4> You can remove the glue easily. When the glue remains on the 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.

14. Production Center

- <1> Panel : LG Philips LCD (Gumi, Korea)
- <2> Module Assembly : LPL NJ (Nanjing, China)
- <3> Shipping Place : LG Philips LCD(Gumi, Korea)