Product Specification

SPECIFICATION
FOR
APPROVAL

( ) Preliminary Specification
(●) Final Specification

Title	4.0” (320 X RGB X 240) TFT- LCD

BUYER	Truly
MODEL	

SUPPLIER	LG.Philips LCD CO.,Ltd.
MODEL	LB040Q02
SUFFIX	TD02

SIGNATURE	DATE
/	
/	
/	

APPROVED BY	DATE
C. S. KYEONG / G. Manager	05. June.2
REVIEWED BY	
S. D. Jung / Manager	05. June.2
PREPARED BY	
H. J. Kim / Project Leader	05. June.2

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

Contents

Product Specification

RECORD OF REVISIONS

Revision No	Revision Date	Page	Description	Note
0.0	March. 21. 2005	-	First Draft (Preliminary)	
0.1	May.16.2005	21	FPC Dimension Change(13.5→30)	
1.0	June. 2. 2005	21	FPC Dimension Drawing update	
		22	Shock Test, Vibration test Condition be changed	
			Shock test Half sine wave, 980m/s^2, 6ms, 3 times shock of each six faces	
			Vibration Test X, Z : 2Hr, Y : 4Hr, 15min. / (axis · sweep) 8 ~ 33.3Hz :The amplitude is 1.3 mm 33.3 ~ 400Hz :The acceleration is 28.4m/ s^2	

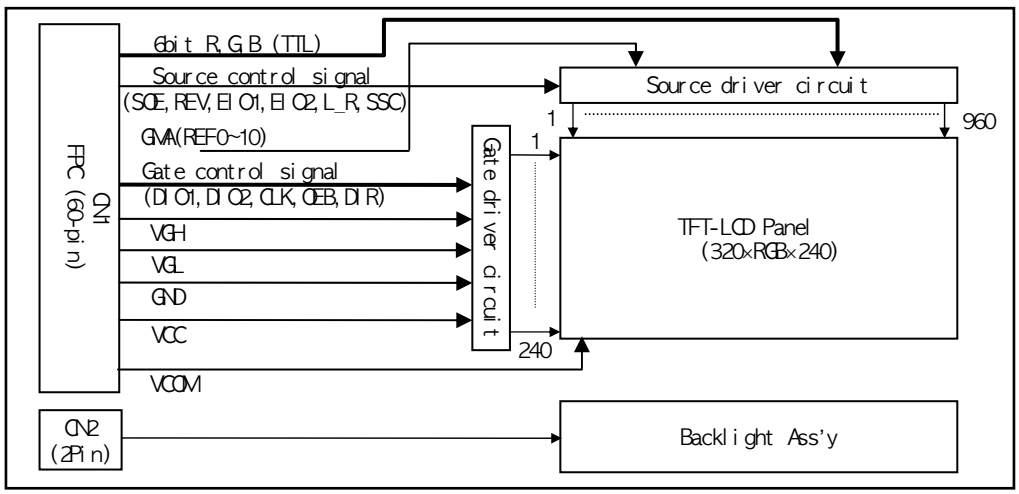
Product Specification

1. Summary

This module utilizes amorphous silicon thin film transistors. A 4.0" active matrix liquid crystal display allows full color to be displayed.
The applications are Car Navigation System, Amusement and others.

2. Features

- The 4.0" screen produces a high resolution image that is composed of 76,800 pixel elements in a stripe arrangement.
- Wide viewing angle technology is employed.
  [The most suitable viewing direction is in the 6 o'clock direction.]
- By adopting an active matrix drive, a picture with high contrast is realized.
- A thin, light and compact module is accomplished through the use of COG mounting technology.
- 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 gray scale signal.



3. General Specification

CHARACTERISTIC ITEM	SPECIFICATION
Signal Interface	Digital Interface (CMOS TTL)
Display Mode	Normally White, Transmitting Type
Screen Size (Diagonal)	4.0" (102 mm)
Outline Dimension	98.4mm (H) X 78.0mm (V) X6.8mm (D)
Active Area	81.6mm (H) X 61.2mm (V)
Number Of dots	320(H) X 3(R,G,B) X 240(V)
Color depth	6 Bit, 262,144 colors
Pixel Pitch	0.085mm(H) × RGB × 0.255mm(V)
Color Filter Array	RGB vertical stripes
Power Consumption (TFT Panel + B/L Ass'y)	2.5 Watt(Typ)
Weight	90g(Typ)
Backlight	CCFL (L Type, 1ea)
Surface Treatment	Top : WV-A, AG, Bottom : WV-A, AG

4. Interface (Input Terminal)

1> TFT-LCD panel driving part

Pin No.	Symbol	I/O	Function	Comment
1	GND	I	Ground	VSS
2	DIO1	I/O	Start Pulse 1 for Gate Driver	
3	VCC	I	Digital Power(3.3V)	
4	GND	I	Power Ground	
5	OEB	I	Output Enable for Gate Driver	
6	CLK	I	Shift Clock for Gate Driver	
7	DIR	I	Direction for Gate Driver	
8	DIO2	I/O	Start Pulse 2 for Gate Driver	
9	VCOM	I	Common Electrode Driving Signal	
10	VGH	I	TFT on Voltage	
11	VGL	I	TFT off Voltage	
12	VGL	I	TFT off Voltage	
13	VCOM	I	Common Electrode Driving Signal	
14	GND	I	Ground	
15	GND	I	Ground	
16	VDD	I	Analog Power (5.0V)	
17	VDD	I	Analog Power (5.0V)	
18	VREF10	I	GMA Reference Voltage	
19	VREF8	I	GMA Reference Voltage	
20	VREF6	I	GMA Reference Voltage	
21	VREF4	I	GMA Reference Voltage	
22	VREF2	I	GMA Reference Voltage	
23	VREF0	I	GMA Reference Voltage	
24	L_R	I	Direction for Source Driver	
25	BD0	I	Blue Data	LSB
26	BD1	I	Blue Data	
27	BD2	I	Blue Data	
28	BD3	I	Blue Data	
29	BD4	I	Blue Data	
30	BD5	I	Blue Data	MSB

Product Specification

Pin No.	Symbol	I/O	Function	Comment
31	SOE	I	Output Enable for Source Driver	
32	EIO1	I/O	Start Pulse 1 for Source Driver	
33	VCC	I	Digital Power(3.3V)	
34	VCC	I	Digital Power(3.3V)	
35	SSC	I	Shift Clock for Source Driver	
36	GND	I	Ground	
37	GND	I	Ground	
38	REV	I	Control signal for Source Driver	
39	EIO2	I/O	Start Pulse 2 for Source Driver	
40	GD0	I	Green Data	LSB
41	GD1	I	Green Data	
42	GD2	I	Green Data	
43	GD3	I	Green Data	
44	GD4	I	Green Data	
45	GD5	I	Green Data	MSB
46	RD0	I	Red Data	LSB
47	RD1	I	Red Data	
48	RD2	I	Red Data	
49	RD3	I	Red Data	
50	RD4	I	Red Data	
51	RD5	I	Red Data	MSB
52	VREF1	I	GMA Reference Voltage	
53	VREF3	I	GMA Reference Voltage	
54	VREF5	I	GMA Reference Voltage	
55	VREF7	I	GMA Reference Voltage	
56	VREF9	I	GMA Reference Voltage	
57	VDD	I	Analog Power (5.0V)	
58	GND	I	Ground	
59	VCOM	I	Common Electrode Driving Signal	
60	VCOM	I	Common Electrode Driving Signal	

•Input connector for the operation of LCD module : FH12K-60S-0.5SH (Hirose), 60Pin 0.5mm pitch or equivalent

2> Backlight fluorescent tube driving part

Terminal	No.	Symbol	Function	Remark
CN1	1	HV	Power Supply For Lamp [High Voltage Side]	[Note 4-1]
	2	LV	Power Supply For Lamp [Low Voltage Side]	[Note 4-2]

The backlight interface connector is a model **BHSR-02VS-1** manufactured by JST or a compatible model
manufactured by AMP. The matching connector part number is **SM02B-BHSS-1-TB** manufactured by JST
or equivalent.

[Note 4-1] The wire color of high voltage side is pink.
[Note 4-2] The wire color of low voltage side is white. Connect the low voltage side of the DC/AC inverter used to drive the fluorescent tube to GND of the inverter circuit.

5. Absolute Maximum Ratings

1> TFT LCD Panel driving part

Parameter			Symbol	Condition	Min.	Max.	Unit	Remark
Logic Part Supply Voltage			VCC	T_a=25℃	-0.3	6.5	V	
Analog Part Supply Voltage			VDD	T_a=25℃	-0.3	6.5	V	
Logic Part Input Voltage			VI (logic input)	T_a=25℃	-0.3	DVDD+0.3V	V	
Analog Part Input Signals			VI (VREF0~VREF10)	T_a=25℃	-0.3	AVDD+0.3	V	
Gate Driver Voltage	TFT	Hi	VGH-VGL	T_a=25℃	-0.3	40	V	
		Lo	VGL	T_a=25℃	-20	0.3	V	
	LOGIC	Hi	VCC	T_a=25℃	-0.3	7.0	V	
		Lo	GND	T_a=25℃	-0.3	+0.3	V	
Storage Temperature			T_{ST}	-	-40	85	℃	
Operating Temperature (Panel Surface)			T_P	-	-30	85	℃	

Stress beyond those listed under “absolute maximum ratings” may cause permanent damage to the device. These are stress ratings only and functional operation of the device at these or any other conditions beyond Those indicated under “ recommended operating conditions” is not implied.
Exposure to absolute-maximum-rated conditions for extended periods may affect device reliability.

Notes: 1. All voltage vaules are with respect to AGND = DGND = 0V
2. Source Power up in the following order:
case1 : DVDD, Control inputs, AVDD, VREF0~10
case2 : DVDD, AVDD, VREF0~10, Control inputs
Power down by reversing the sequence.
3. Gate Power up in the following order;
: No Power On/Off Sequences are required

6. Electrical Characteristics

1> Recommended Operating Condition

◈ TFT-LCD Panel Driving Section

T_a=25℃

Parameter			Min	Typ	Max	Unit
Supply Voltage		VDD	4.5	5.0	5.5	V
		VCC	3.0	3.3	3.6	V
Gamma Correction Potential		VREF0 ~VREF10	GND +0.1		VDD-0.1	V
Data Clock Frequency, fclk		VCC : 2.7V ~ 3.6V	5	6.3	6.8	MHz
VIH	High Level Input Voltage	Dx[5:0],SOE, EIO1,EIO2,L/R, REV,SSC	0.7VCC			V
VIL	Low Level Input Voltage	Dx[5:0],SOE, EIO1,EIO2,L/R, REV,SSC			0.3VCC	V

ITEM	SYMBOL	MIN	TYP	MAX	UNIT
Supply Voltage	VCC	3.0	3.3	3.6	V
Supply Voltage	VGH	10	18	28	V
Supply Voltage	VGL	-15		-2	V
Voltage Difference	VGH-VGL	17		38	V
Voltage Difference	VCC-VGL	5		20	V
Input Voltage	Vin	Vss-0.3		VCC+0.3	V
Operating Frequency	Fclk			150	KHz

Notes] Recommended VGL : -7.5 ~ -12.5

PARAMETER	SYMBOL	MIN.	TYP.	MAX.	UNIT	REMARK
Logic Supply Current	I_{VCC}	-	-	50	mA	VCC = 3.3V
Source Driver Supply Current	I_{VDD}	-	-	30	mA	VDD = 5.0V
Gate Driver High Supply Current	I_{GH}	-	-	5	mA	VGH=17V
Gate Driver Low Supply Current	I_{GL}	-	-	15	mArms	VGL=-12.5~-7.5V

Product Specification

◈ Backlight Driving Section

T_a=25℃

Parameter	Symbol	Min.	Typ.	Max.	Unit	Remark
Lamp Current	I_{BL}	3.0	6.0	6.5	mArms	
Lamp Voltage	V_{BL}	370	390	510	Vrms	±10[%]
Lamp Power Consumption	P_{BL}	-	2.34	2.57	W	I_{BL}=6.0mArms
Lamp Frequency	f_{BL}	35	60	80	KHz	*2
Kick-Off Voltage (*3)	V_S	-	-	980	Vrms	T_a=25℃
		-	-	1260	Vrms	T_a= -30℃
Discharge Stabilization Time	T_S	-	-	3	Minutes	*4
Life Time	-	20,000	-	-	Hour	*5

Note)
The design of the inverter must have specifications for the lamp in LCD Assembly. The performance
of the Lamp in LCM, for example life time or brightness, is extremely influenced by the characteristics of the DC-AC inverter. So all the parameters of an inverter should be carefully designed so as not to produce too much leakage current from high-voltage output of the inverter. When you design or order the inverter, please make sure unwanted lighting caused by the mismatch of the lamp and the inverter(no lighting, flicker, etc) never occurs. When you confirm it, the LCD Assembly should be operated in the same condition as installed
in your instrument.

* 1. VCC=3.3V, 25°C, f_V (frame frequency) = 60Hz condition, whereas mosaic pattern(Typ),full black pattern(Max) is displayed. [LDO output voltage(3.3V) is applied.]
* 2. This frequency range means the range to keep within ±10% change of electrical and optical characteristics.
* 3. This frequency range means not affecting to lamp life and reliability characteristics. (The lamp frequency should be selected as different as possible from display horizontal synchronous signal (Including harmonic frequency of this scanning frequency) to avoid “Beat” interference which may be observed on the screen as horizontal stripes like moving wave.

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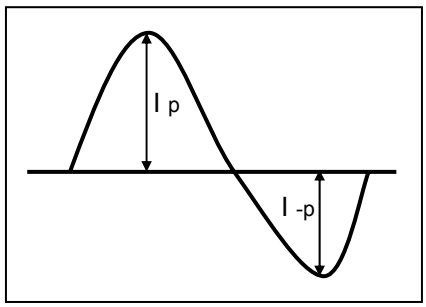
This phenomenon is caused by interference between lamp (CCFL) lighting frequency and LCD horizontal synchronous signal.)

* 4. The "MAX" of "Kick-Off Voltage" means the minimum voltage for inverter to turn on the CCFL normally in the LCD module. However this isn't the values that we can assure stability of starting lamp on condition that the module is installed in your set.
It should be careful that "Kick-Off Voltage" is changed by an increase of stray capacitance in your set, inverter method, value of ballast capacitor in your inverter and so on.
Especially, the value of "Kick-Off Voltage" is higher in low temperature condition than in normal temperature condition, because impedance of CCFL is increased.
The voltage above V_S should be applied to the lamps for more than 1 second for start-up.
Otherwise, the lamps may not be turned on. The used lamp current is the lamp typical current.

* 5. The time needed to achieve not less than 95%brightness of the center part of lamp.
The brightness of the lamp after being lighted for 5 minutes is defined as 100%.

* 6. "Life time" is defined as the time that the lamp brightness decreases to 50% from original brightness
at I_{BL}=TYP; continuous lighting, T_a=25℃ .



* Asymmetry rate:

$$(I_p - I_{-p}) / I_{rms} * 100\%$$

•Distortion rate:

$$I_p \text{ (or } I_{-p}) / I_{rms}$$

Requirements for a system inverter design, which is intended to have a better display performance, a better power efficiency and a more reliable lamp, are as follows. It shall help increase the lamp lifetime
and reduce leakage current. Inverter should be designed to be subject to the conditions below

A. The asymmetry rate of the inverter waveform should be less than 10%.
B. The distortion rate of the waveform should be within $\sqrt{2} \pm 10\%$.
* Inverter output waveform had better be more similar to ideal sine wave.
C. There should not be any spikes in the waveform.
D. Lamp current should not exceed the "MAX" value under the "Operating Temperature" (it is prohibited to exceed the "MAX." value even if it is operated in the guaranteed temperature).
When lamp current exceed the maximum value for a long time, it may cause a smoking and Ignition.
Therefore, it is recommended that the inverter have the current limited circuit that is used as a protection circuit and/or the lamp current-controlled inverter.

∗ Do not attach a conducting tape to lamp connecting wire.
If the lamp wire attach to a conducting tape, TFT-LCD Module has a low luminance and the inverter has abnormal action. Because leakage current is occurred between lamp wire and conducting tape.

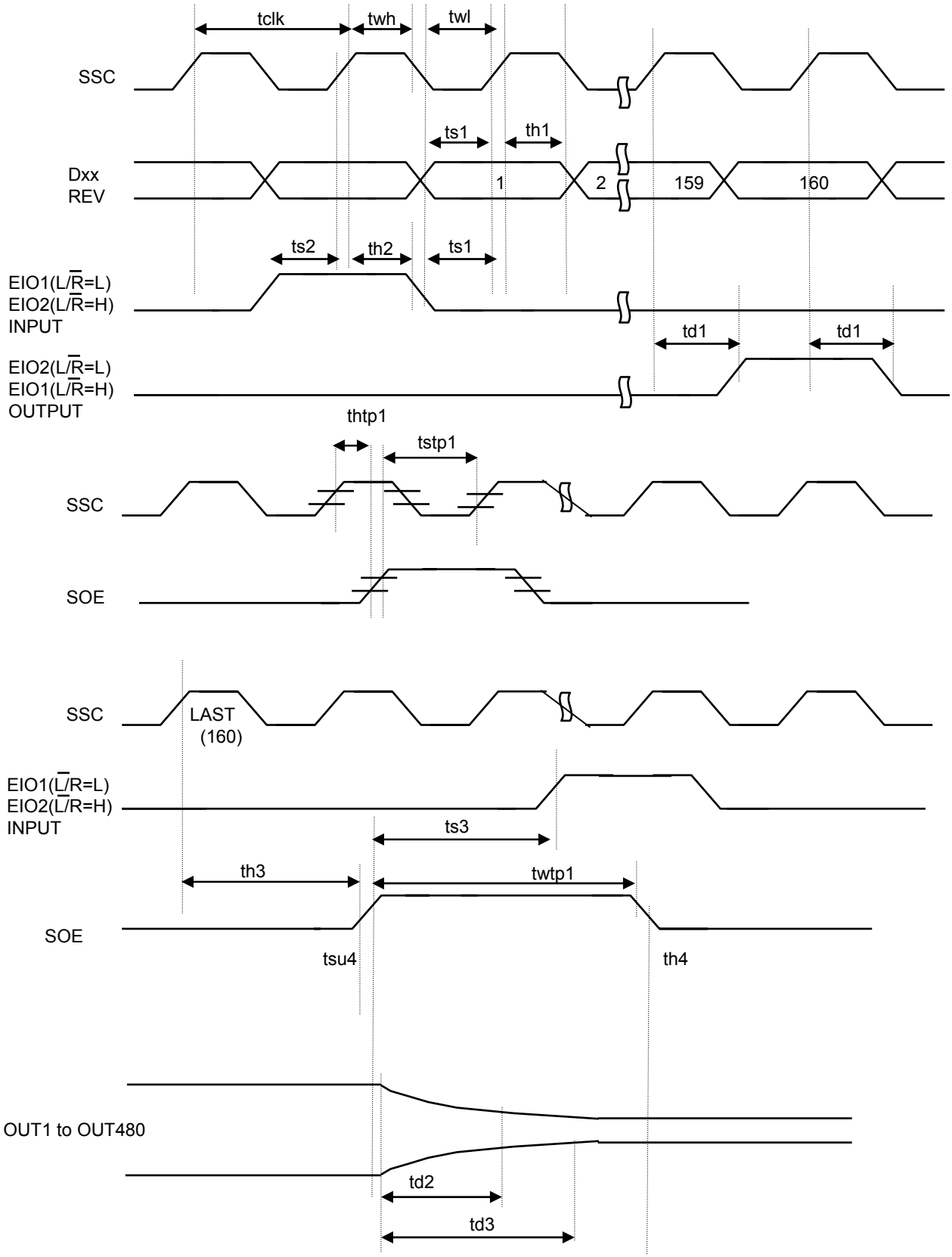
Product Specification

4> Timing Characteristics of input requirements

4-1>Source D-IC Timing Requirements (HM10S615A)

Parameter		Test Conditions	MIN	TYP	MAX	Unit
tclk	DCLK cycle time	- See Fig 4	15.3			ns
twh	High level CLK pulse width duration	- See Fig 4	4			ns
twl	Low level DCLK pulse width duration	- See Fig 4	4			ns
ts1	Data/REV setup time	- See Fig 4	2			ns
th1	Data/REV hold time	- See Fig 4	2			ns
ts2	Start pulse setup time	- See Fig 4	2			ns
th2	Start pulse hold time	- See Fig 4	2			ns
td1	Start pulse signal delay time (Load = 10pF)	- See Fig 4			10	ns
td2	LCD drive signal delay time	- See Fig 4			3	μs
td3		- See Fig 4			8	μs
tstp1	SOE -SSC setup time	- See Fig 4.	2			ns
thtp1	SOE -SSC hold time	- See Fig 4.	2			ns
ts3	SOE signal(input) setup time	- See Fig 4.	3			CLK
th3	SOE low hold time from final data CLK	- See Fig 4.	0			CLK
twtp1	High level SOE signal pulse width duration	- See Fig 4.	2			CLK

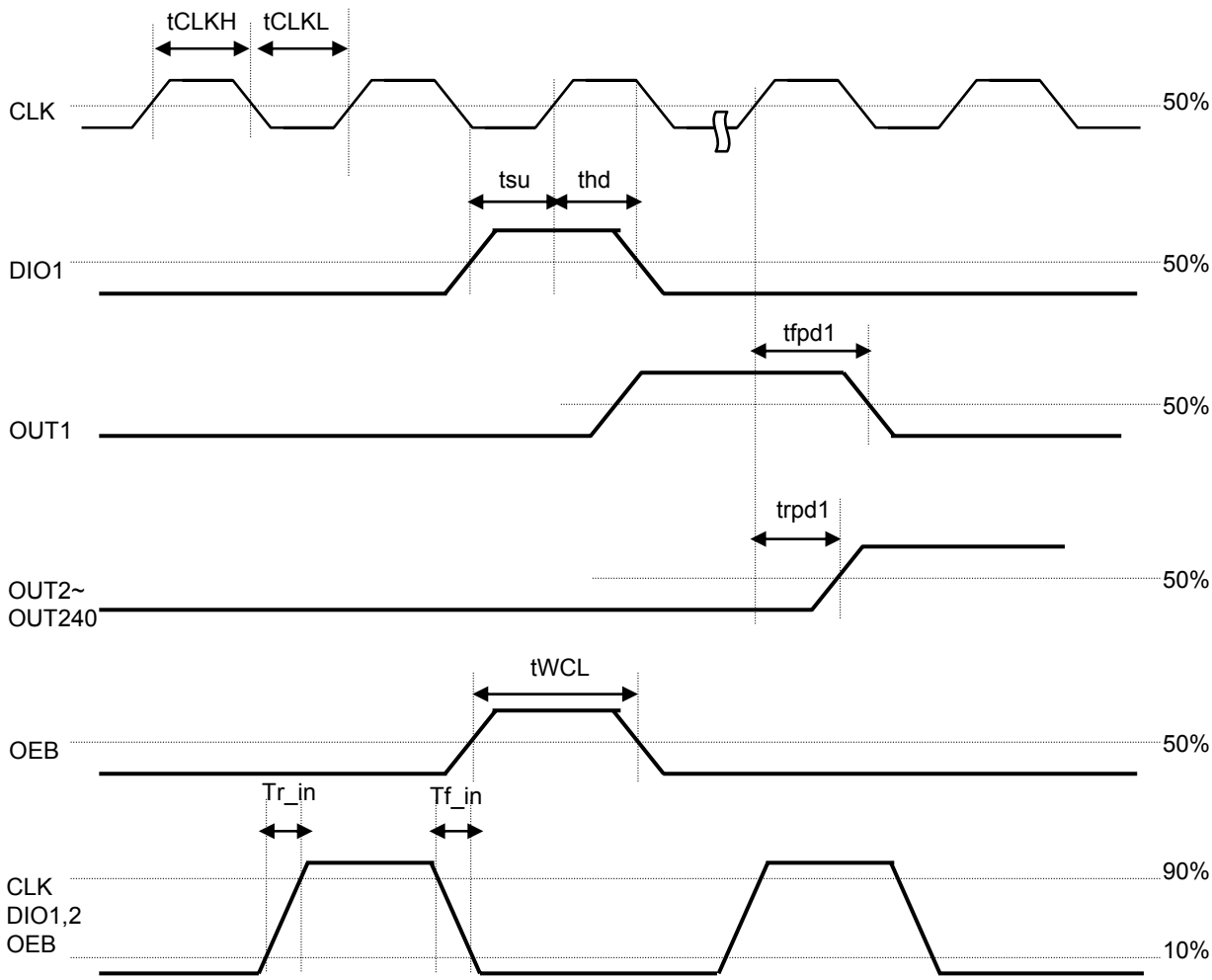
Product Specification



Source D-IC Timing Waveform

4-2> Gate D-IC Timing Requirements (HM10G240A)

Parameter		Conditions	MIN	MAX	Unit
f_{clk}	Clock frequency (CLK)			500	KHz
tCLKH, tCLKL	CLK clock pulse width	Duty=50%	3.0		us
tWCL	OEB signal pulse width		1.0		us
tsu	Data setup time (CLK, DIO1)		700		ns
thd	Data hold time (CLK, DIO1)		700		ns
trpd1	Output delay time1	CL=300pF		500	ns
tfpd1	Output delay time2	CL=300pF		500	ns
Tr_in	Input signal rising time			150	ns
Tf_in	Input signal falling time			150	ns



Gate D-IC Timing Waveform

5> Left/Right,Up/Down terminal (Signal For Reverse Scanning)

#1. Normal Scan Direction

<Source Driver>
L/R = " L"
EIO1 → 480Ch … → 1Ch → EIO2

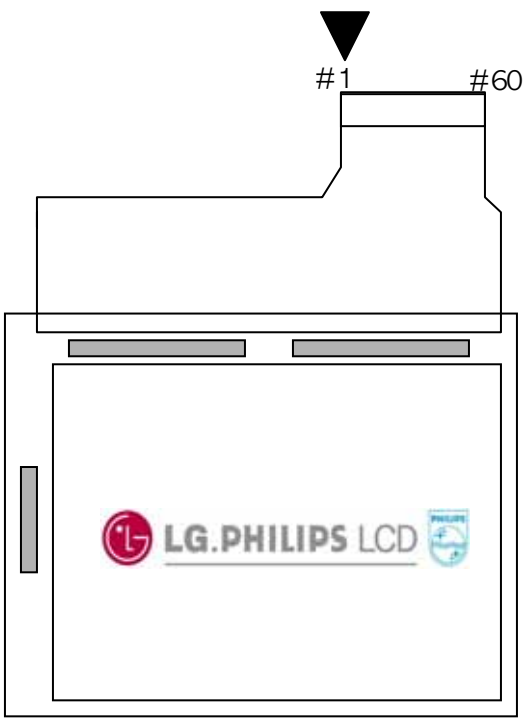
<Gate Driver>
DIR = " L"
DIO2 → 240Ch → … → 1Ch → DIO1

#2. Reverse Scan Direction

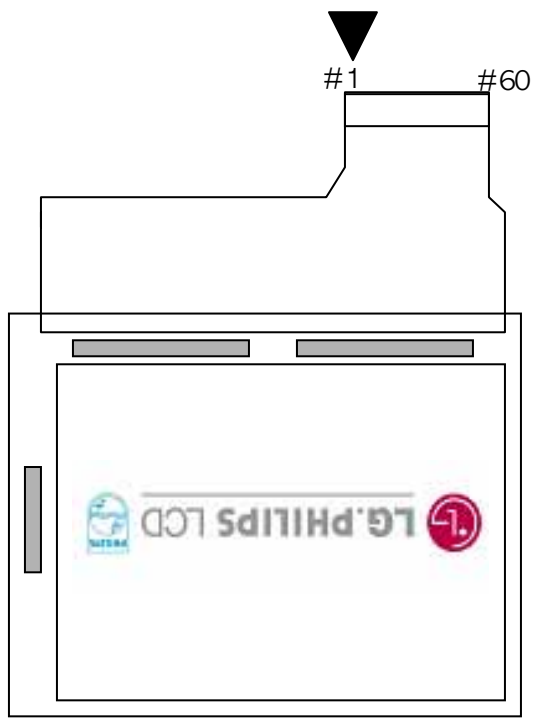
<Source Driver>
L/R = " H"
EIO2 → 1Ch … → 480Ch → EIO1

<Gate Driver>
DIR = " H"
DIO1 → 1Ch → … → 240Ch → DIO2

<Normal Scan Direction>



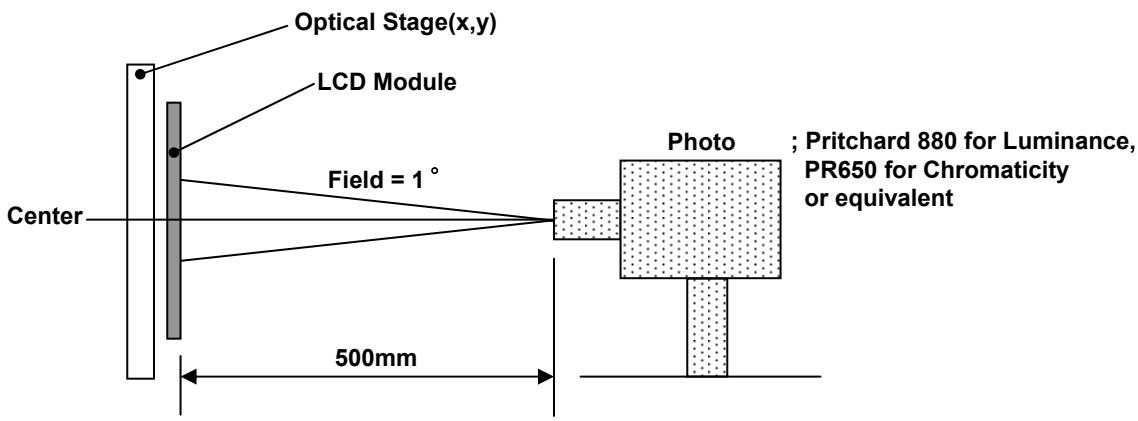
<Reverse Scan Direction>



7. Electro-optical Characteristics

T_a=25℃

Parameter		Symbol	Condition	Min.	Typ.	Max.	Unit	Remark
Luminance		Y	I_{BL}=6mArms	360	450	-	cd/m^2	[Note 7-1]
Contrast Ratio		CR	Optimal	280	400	-	-	[Note 7-2]
White Color Chromaticity		W_x	I_{BL}=6mArms	0.283	0.313	0.343	-	[Note 7-1]
		W_y		0.299	0.329	0.359	-	
Viewing Angle	ϕ=180°	θl	CR≥5	60	65	-	°	[Note 7-2] [Note 7-3]
	ϕ=0°	θr		60	65	-	°	
	ϕ=90°	θu		40	50	-	°	
	ϕ=270°	θd		60	65	-	°	
Response Time	Rise	τ_r	θ=0°	-	10	20	ms	[Note 7-4]
	Fall	τ_d		-	30	45	ms	
Luminance Uniformity		U	I_{BL}=6mArms	-	1.20	1.40	-	[Note 7-5]



Measuring Condition ;
-Measuring surroundings : Dark Room
-Measuring temperature : T_a=25℃
-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 30 minutes while backlight turning on.

[Note 7-1]

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

[Note 7-2]

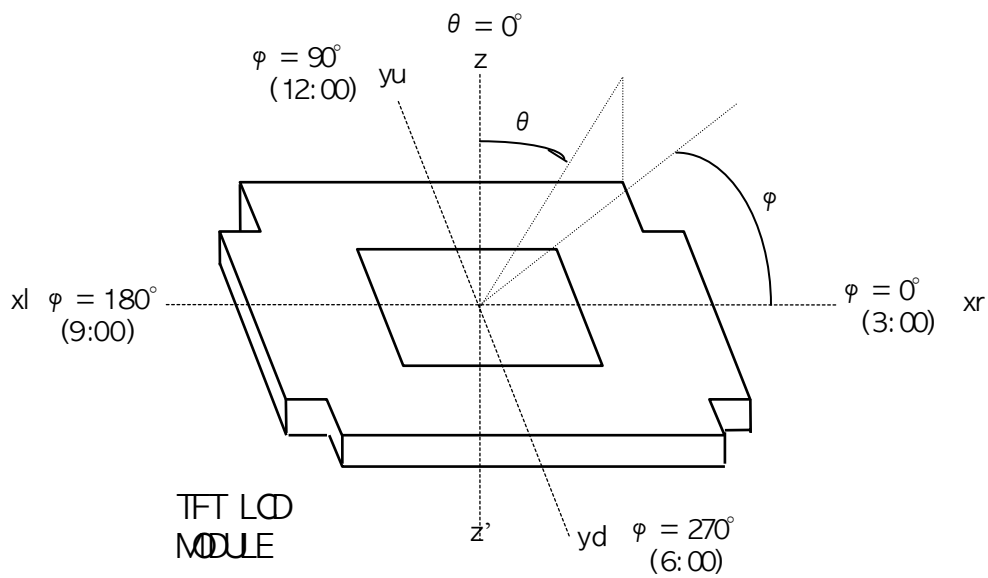
Contrast ratio is defined as follows ;

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

[Note 7-3]

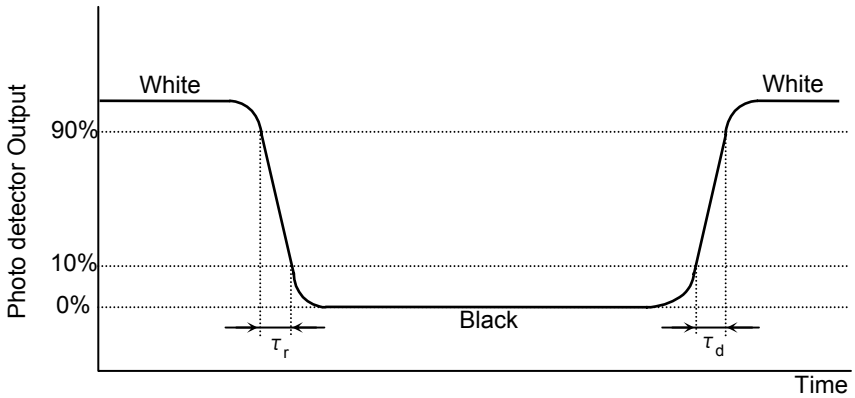
Viewing angle range is defined as follows;

<Dimension of viewing angle range>



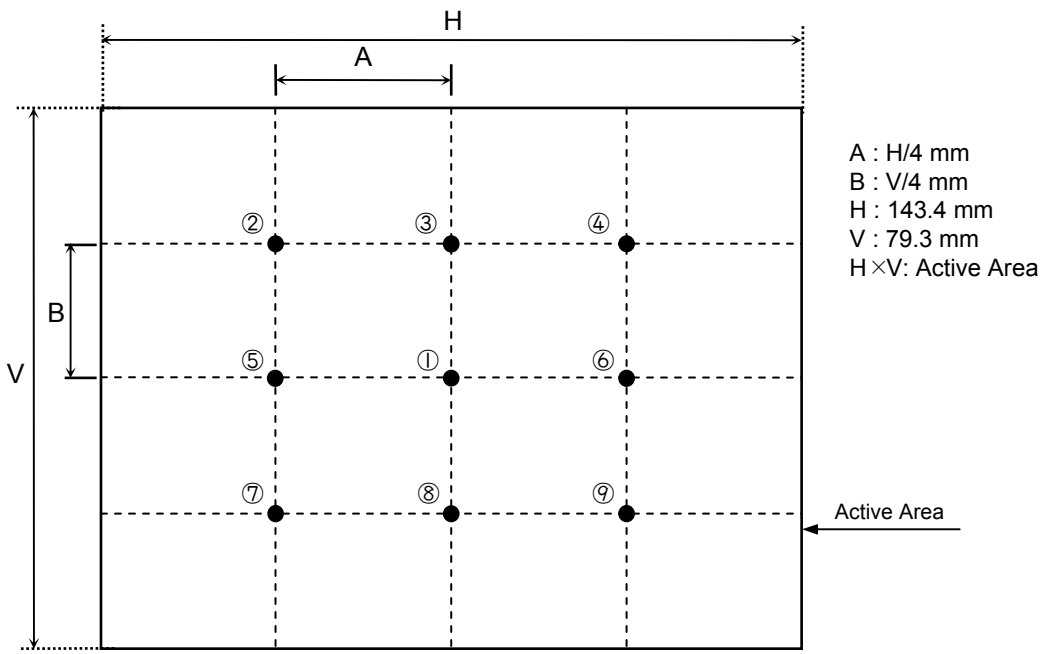
[Note 7-4]

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 7-5]

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

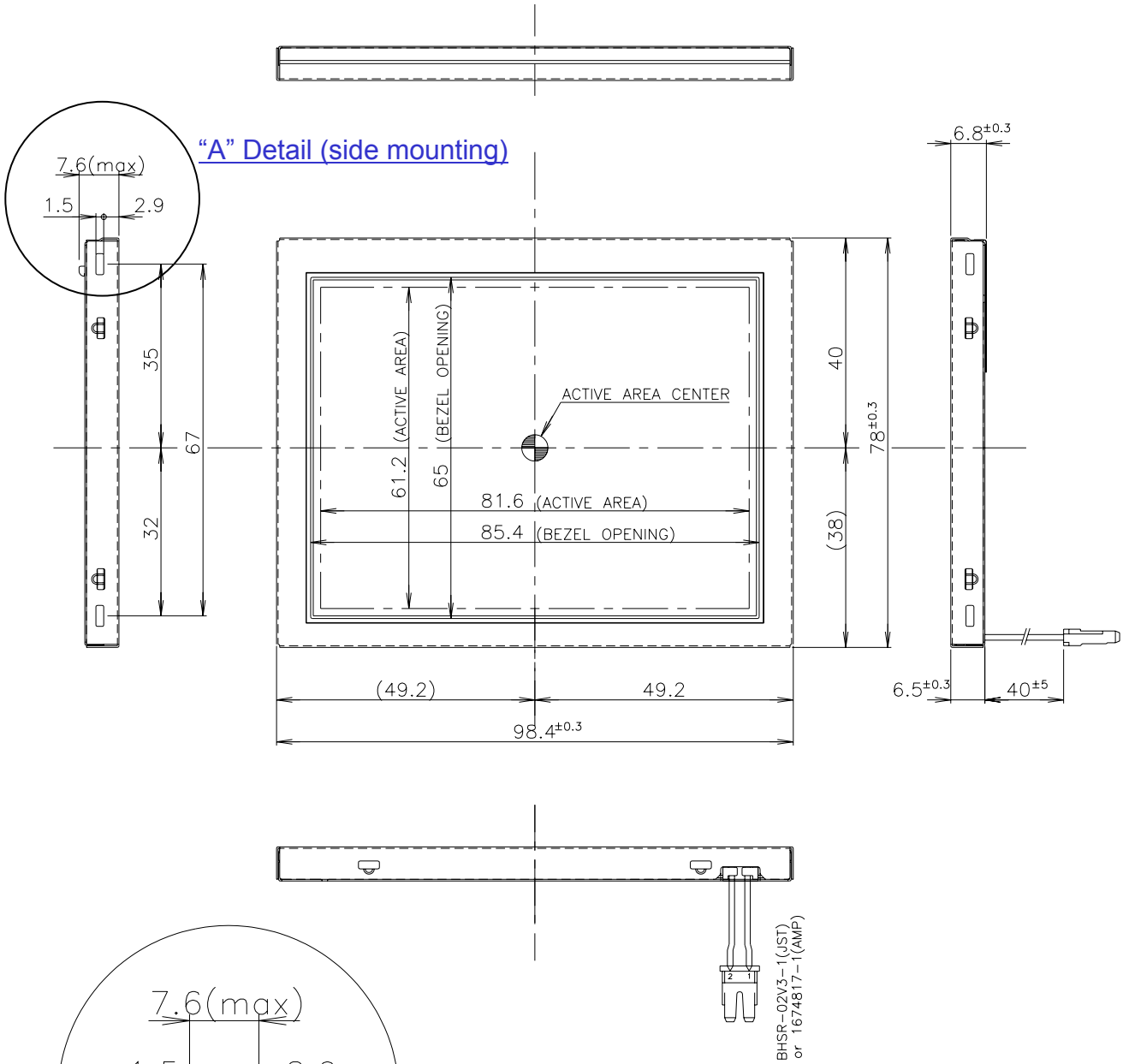


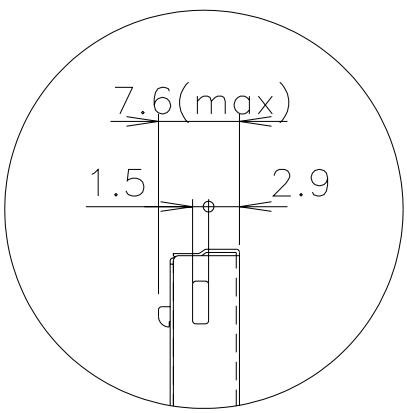
8. Mechanical Characteristics

Parameter	Specification		Unit
Outline Dimension	Width	98.4	mm
	Height	78.0	mm
	Depth	6.8	mm
Active Display Area	Width	81.6	mm
	Height	61.2	mm
Weight	90 (Typ.)	100(Max)	g

Product Specification

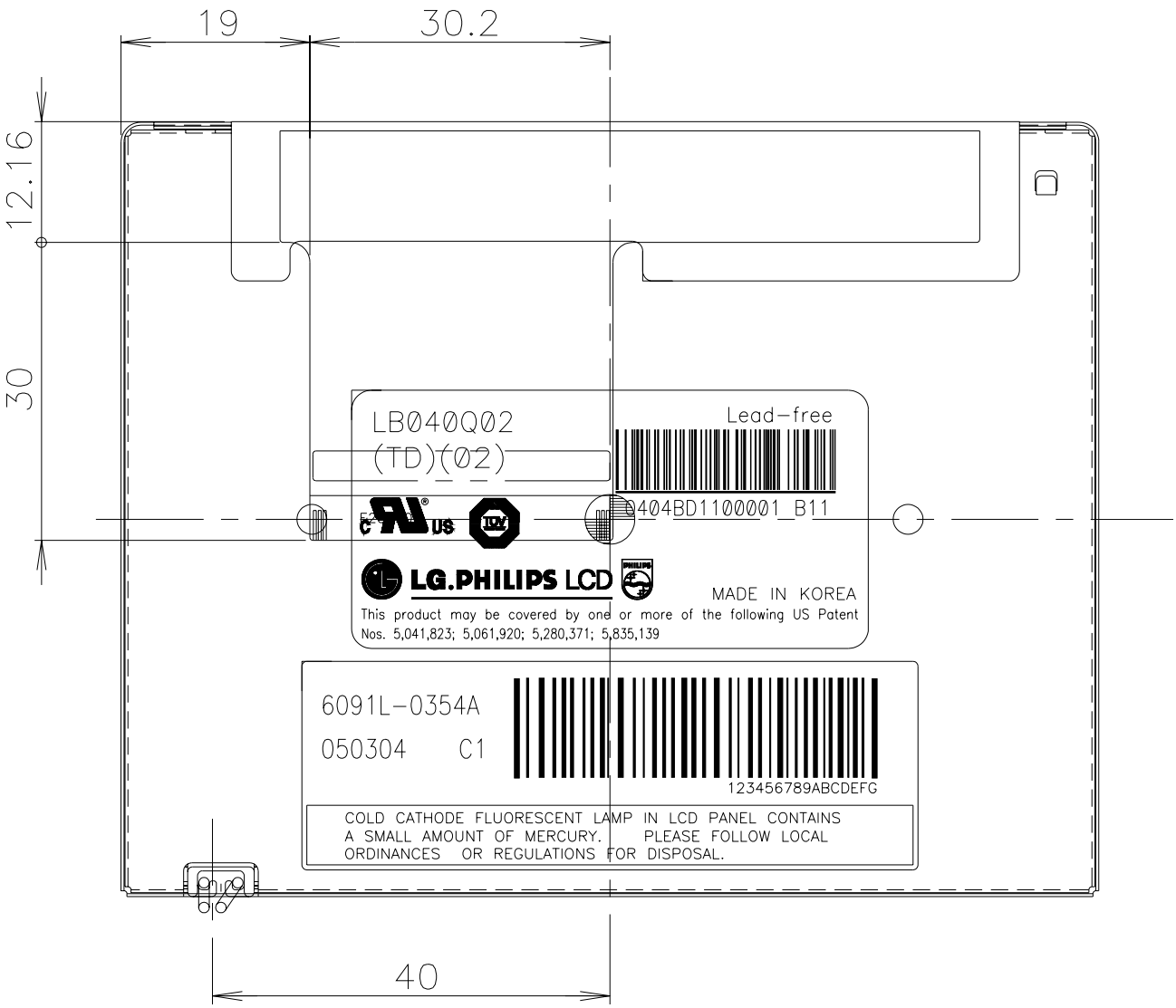
<Front View>





"A" Detail (side mounting)
(System assembly by Hook)
- Depth 0.8mm max (4 side are same)

<Rear View>


19
30.2
12.16
30
LB040Q02
(TD)(02)
Lead-free
0404BD1100001_B11
LG.PHILIPS LCD
MADE IN KOREA
This product may be covered by one or more of the following US Patent Nos. 5,041,823; 5,061,920; 5,280,371; 5,835,139
6091L-0354A
050304 C1
123456789ABCDEFG
COLD CATHODE FLUORESCENT LAMP IN LCD PANEL CONTAINS A SMALL AMOUNT OF MERCURY. PLEASE FOLLOW LOCAL ORDINANCES OR REGULATIONS FOR DISPOSAL.
40

9. Reliability Test

No.	Test Items	Test Condition	REMARK
1	High Temperature Storage Test	Ta=85℃ 240h	1
2	Low Temperature Storage Test	Ta=-40℃ 240h	1
3	High Temperature Operation Test	Tp=85℃ 240h	1
4	Low Temperature Operation Test	Ta=-30℃ 240h	1
5	High Temperature and High Humidity Operation Test	Ta=65℃ 90%RH 240h	1
6	Electro Static Discharge Test	-Panel Surface/Top_Case : 150pF ±15kV 150Ω (direct discharge, five times) -FPC input terminal : 100pF ±200V 0Ω	
7	Shock Test (non-operating)	Half sine wave, 980m/s^2, 6ms, 3 times shock of each six faces	
8	Vibration Test (non-operating)	X, Z : 2Hr, Y : 4Hr, 15min. / (axis · sweep) 8 ~ 33.3Hz :The amplitude is 1.3 mm 33.3 ~ 400Hz :The acceleration is 28.4m/ s^2	
9	Thermal Shock Test	-30℃ (0.5h) ~ 85℃ (0.5h) / 100 cycles	1

***** T_a= Ambient Temperature, Tp = Panel Surface Temperature.

***** Evaluation result criteria : Under a display quality test conditions with normal operation state, there shall be no change which may affect practical display function.

10. International Standards

10-1. Safety

a) UL 60950, Third Edition, Underwriters Laboratories, Inc., Dated Dec. 11, 2000.
Standard for Safety of Information Technology Equipment, Including Electrical Business Equipment.
b) CAN/CSA C22.2, No. 60950, Third Edition, Canadian Standards Association, Dec. 1, 2000.
Standard for Safety of Information Technology Equipment, Including Electrical Business Equipment.
c) EN 60950 : 2000, Third Edition
IEC 60950 : 1999, Third Edition
European Committee for Electro technical Standardization(CENELEC)
EUROPEAN STANDARD for Safety of Information Technology Equipment Including Electrical Business Equipment.

11. Display Quality

The display quality of the color TFT-LCD module shall be in compliance with the Incoming Inspection Standard.

12. Packing

12-1. 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 : FACTORY CODE
G : ASSEMBLY 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

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.

12-2. Packing Form

a) Package quantity in one box : 156 pcs

b) Box Size : 475 x 348 x 341 (mm)

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 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 and toluene 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.

13-2. 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 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 minimized the interference.

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

- Panel : LG Philips LCD (Gumi, Korea)
- Module Assembly : Heesung(Daegu, Korea)
- Shipping Place : LG Philips LCD(Gumi, Korea)