

# **SPECIFICATIONS FOR LCD MODULE**

**MODEL NO.  
BP320240A-FPENH\$000  
VER.02**



FOR MESSRS:

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ON DATE OF:

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APPROVED BY:

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**BOLYMIN, INC.**

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## History of Version

Version	Contents	Date	Note
01	NEW VERSION	2019/09/20	SPEC.
02	Change FFC thickness from 0.24 to 0.136mm.	2020/01/13	SPEC.

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## 1. Numbering System

B	P	320240	A	-	F	P	E	N	H		\$	000
0	1	2	3		4	5	6	7	8	9	10	11

0	Bolymin	B			
1	Module Type	C	Character type	P	TAB /TCP type
		F	COF type	R	Color STN
		G	Graphic type	L	OLED
		O	COG type	Z	Customize
2	Format	2004	20 character type,4lines		
		12232	122 × 32 dots		
3	Version No.	A			
	-				
4	LCD Color	B	STN / Blue, OLED/Blue	H	HTN
		C	Color	T	TN
		F	FSTN	Y	STN/Yellow-green
		G	STN/Grey	D	OLED/Blue+Yellow
		A	OLED/Blue+Yellow+Green	E	OLED/Yellow
		L	OLED/Green	R	OLED/RED
		W	OLED/White	J	ASTN
		K	DFSTN	V	VA LCD
5	LCD Type	R	Positive/reflective	M	Positive/ transmissive
		P	Positive/transflective	N	Negative/ transmissive
		T	Negative/ transflective		
6	Backlight type/color	L	(LED)Array/yellow-green	G	(LED)Edge/yellow-green
		M	(LED)Array/amber	H	(LED)Edge/white
		R	(LED)Array/red	D	(LED)Edge/blue
		U	(LED)Array/blue	E	(EL)white
		W	(LED)Array/white	B	(EL)blue
		C	(CCFL)white	F	(LED)Array/RGB
		Y	(LED)Array/yellow	N	No backlight
		O	(LED)Array/orange	K	(LED)Edge/green
		A	(LED)Edge/amber	Q	(LED)Edge/red
		J	(LED)Array/green	I	(LED)Edge/RGB
		Z	(LED)Array Red/YG	P	(LED)Edge/orange

		S	(LED)edge/RGW	T	(LED)edge red/green
		V	EL blue/green`	X	(LED) Edge white / red
7	CGRAM Font	J	English/Japanese Font	C	English/Cyrillic Font
		G	Chinese (Simple)	H	English/Hebrew Font
		E	English/European Font	B	English/Japanese/European
		F	Chinese (Traditional)	N	Without Font
		Z	Z=Chinese(simple)+Chinese (traditional)+Japanese+Korean	K	Korean (only for BG16032A BG24064C)
		A	English/Arabic Font	D	Chinese (simple/traditional) English/Japanese
		B	English/Japanese/European	N	None
8	View Angle /Operation Temperature	B	6:00 /Normal Temperature	W	12:00 /Wide Temperature
		H	6:00 /Wide Temperature	E	12:00 /Ultra Temperature
		C	9:00 /Normal Temperature	U	6:00/Ultra wide Temperature
		T	12:00 /Normal Temperature	F	9:00/Ultra wide Temperature
		G	3:00 /Wide Temperature	D	9:00 /Wide Temperature
		I	3H/ Ultra Wide Temperature 3:00		
9	Special Code	N	Negative voltage for LCD	T	Negative voltage and Temperature compensation for LCD
		P	Touch panel	3/5	3/5 voltage logic power supply
10	RoHS	\$			
11					

## 2. Handling Precaution

### 2.1 Precaution in use of LCD Module

- 2.1.1. LCD panel is made of glass. Avoid excessive mechanical shock or applying strong pressure and/or sharp tools on the surface of display area.
- 2.1.2. The polarizer placed on the display surface is easily scratched and damaged. Extreme care should be taken when handling it. To clean dust or dirt off the display surface, wipe gently with cotton, or other soft material soaked with isopropyl alcohol, ethyl alcohol, do not use water, ketone or aromatics to clear display surface, and never scrub it hard.
- 2.1.3. Keep LCD panels away from direct sunlight. The storage environment should be dust-free, clean, dry, temperature is  $25^{\circ}\text{C} \pm 10^{\circ}\text{C}$  and the humidity is below 55% RH.
- 2.1.4. Do not input any signal before power is turned on.
- 2.1.5. Avoid pressing on the metal bezel, otherwise the elastomer connector could be deformed and lose contact, resulting in missing pixels and also cause rainbow on the display.
- 2.1.6. It's important to control soldering temperature and time. RoHS compliant materials might need higher temperature and time, but try to keep temperature under  $350^{\circ}\text{C}$  and time in 3-5 sec.
- 2.1.7. EL is manufactured from the organic film, and is easily affected by temperature, humidity and other environmental impact. Long time storage might cause low quality of the case. Therefore, please start production in 3 months after reception of the LCM. If in any case, long time storage over 3 months is necessary, please keep EL in vacuum package or at least in humidity  $< 35\%$  RH, and temperature  $25^{\circ}\text{C} \pm 10^{\circ}\text{C}$ .  
Note: 2.1.7. is applied to EL backlight only.

### 2.2 Static Electricity Precautions:

- 2.2.1. The LCD module contains a C-MOS LSI. People who operate the LCM should wear ESD protection equipment to prevent ESD hurt on products.
- 2.2.2. Do not touch any of the conductive parts such as the LSI pads; the copper leads on the PCB and the interface terminals with any parts of the human body.
- 2.2.3. Do not touch the connection terminals of the display with bare hand; it will cause disconnection or defective insulation of terminals.
- 2.2.4. The modules should be kept in anti-static bags or trays for storage.
- 2.2.5. Only properly grounded soldering irons should be used.
- 2.2.6. If an electric screwdriver is used, it should be grounded and shielded to prevent sparks.
- 2.2.7. The normal static prevention measures should be observed for work clothes and working benches.
- 2.2.8. Since dry air(almost low RH) is inductive to static, a humidity of 50-60% RH is recommended in assembly line.

### 2.3 Operation Precautions:

- 2.3.1. DC voltage applied on LCM causes electrochemical reactions, which will deteriorate the display over time. The applied pulse waveform should be a symmetric waveform such that no DC component remains. Be sure to use the specified operating voltage.
- 2.3.2. LCD driving voltage should be kept within specified range; excess voltage will shorten display life, while less voltage may not turn on LCM.
- 2.3.3. LCM response time will be extremely delayed in low operating temperature(such as  $-20^{\circ}\text{C}$ ) than in room operating temperature. Therefore, higher LCD driving voltage is required in low operating temperature; On the other hand, in high operating temperature (such as  $+70^{\circ}\text{C}$ ) LCD shows dark background color, therefore lower LCD driving voltage is required. Be sure to use the specified LCD driving voltage in different operating temperature.

## **2.4 Safety:**

2.4.1 If the LCD panel breaks, be careful not to get the liquid crystal to touch your skin.

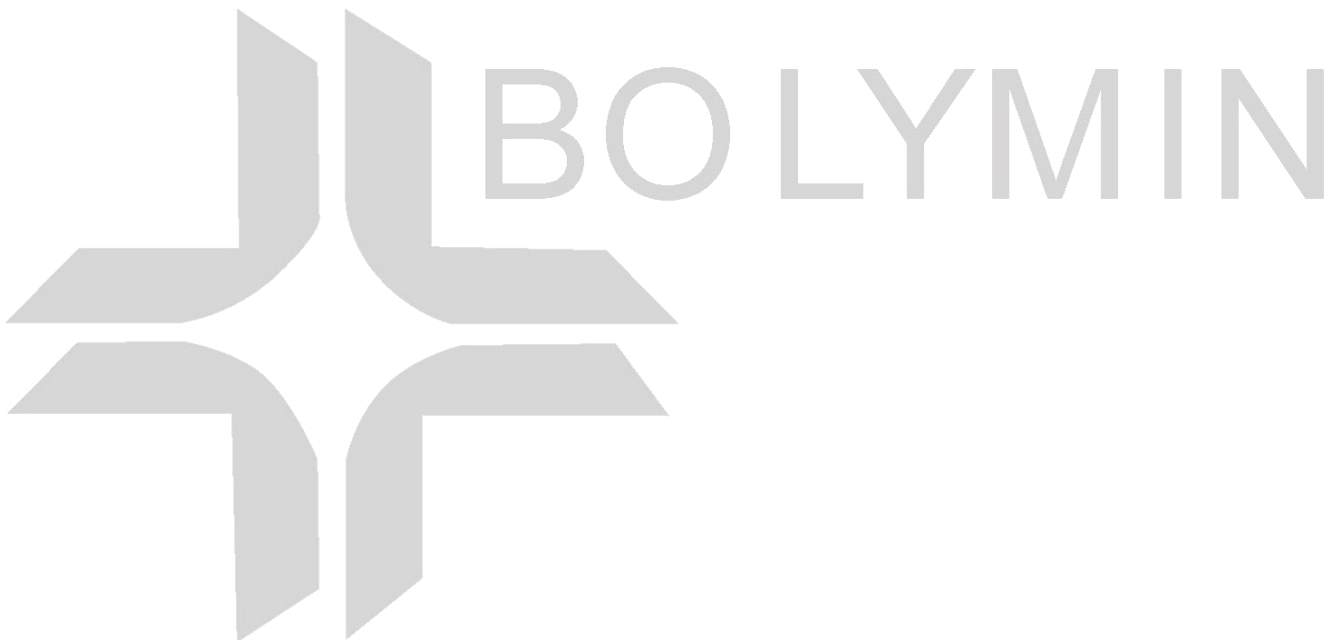
If the liquid crystal touches your skin or clothes, please wash it off immediately by using soap and water.

## **2.5 WARRANTY POLICY**

**Bolymin .Will provide one-year warranty for the products only if under specification operating conditions.**

**If there are functional defects found during the period of warranty, the defective products would be replaced on a one-to-one basis.**

**Bolymin would not be responsible for any direct/indirect liabilities consequential to any parties.**



### 3. General Specification

#### (1) Mechanical Dimension

Item	Standard Value	Unit
Number of dots	320x240	dots
Module dimension (L x W x H)	92.2*73.3*7.8 (max)	mm
View area	81.4*62.0	mm
Active area	76.785*57.585	mm
Dot size	0.22x 0.22	mm
Dot pitch	0.24 x 0.24	mm

(2) Controller IC: No built-in controller (Recommended controller: RAIO 8835)

### 4. Absolute Maximum Rating

#### 4.1 Electrical Absolute Maximum Ratings

(V<sub>SS</sub>=0V, T<sub>a</sub>=25°C)

Item	Symbol	Min	Typ	Max	Unit
Input Voltage	V <sub>I</sub>	-0.3	—	V <sub>DD</sub> +0.3	V
Supply Voltage For Logic	V <sub>DD</sub> -V <sub>SS</sub>	0.3	—	+7	V
Supply Voltage For LCD	V <sub>ADJ</sub> -V <sub>SS</sub>	0.3	—	25	V

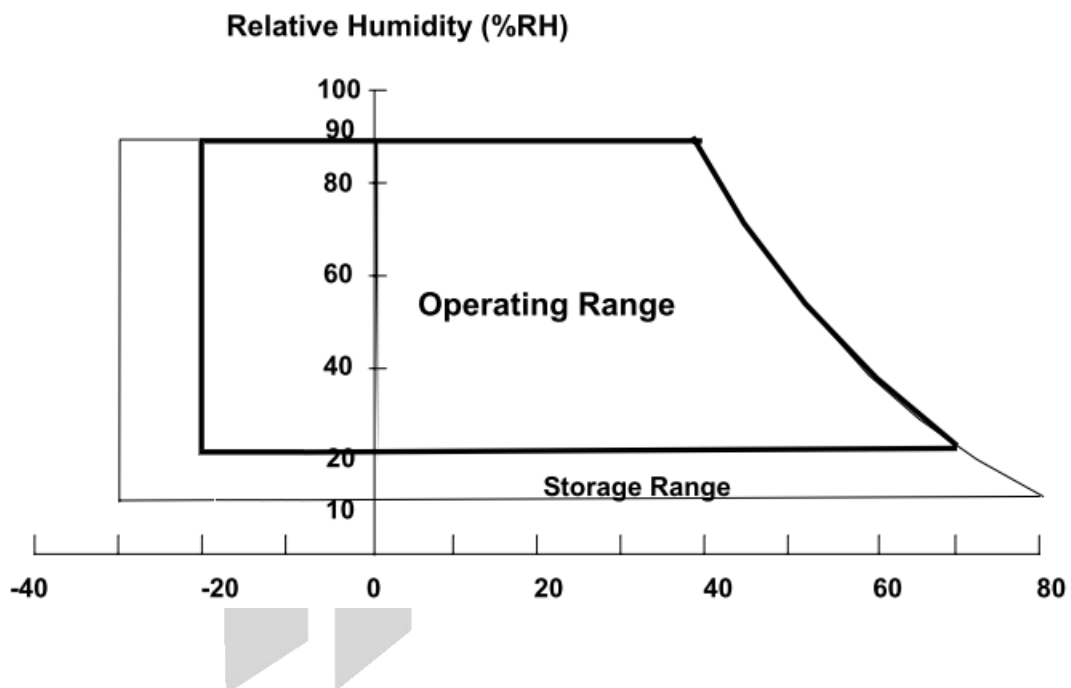


## 4.2 Environmental Absolute Maximum Ratings

Item	Symbol	Min	Max	Unit	Note
Operating Temperature	TOP	-20	70	°C	(1)
Storage Temperature	TST	-30	80	°C	(1)

Note (1)

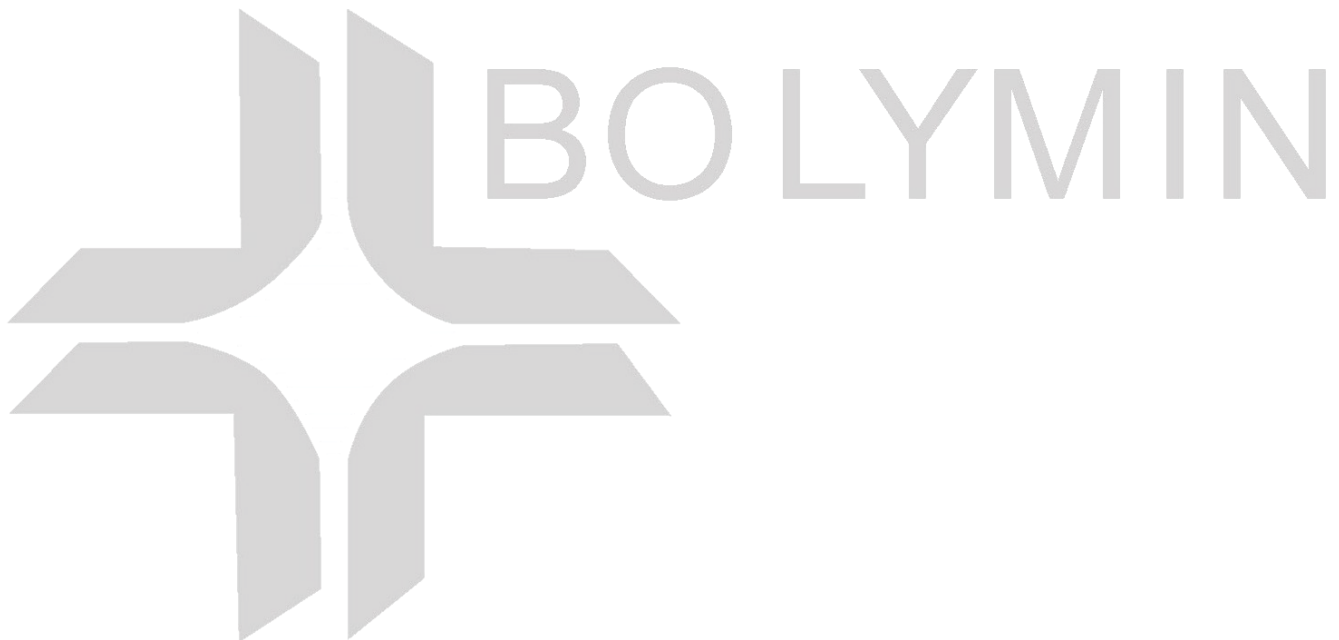
- (a) 90 %RH Max. ( $T_a \leq 40\text{ °C}$ ).
- (b) Wet-bulb temperature should be 39 °C Max. ( $T_a > 40\text{ °C}$ ).
- (c) No condensation.



## 5. Electrical Characteristics

Parameter	Symbol	Condition	Min	Typ	Max	Unit
Supply Voltage For Logic	VDD-VSS	-	2.7	3.3	3.7	V
Supply Voltage For LCD * Wide Temp 、 Type	VADJ-VSS	25°C	17.2	17.5	17.8	V
Input Voltage	VIH	-	0.8 VDD	--	VDD	V
	VIL	-	VSS	--	0.2 VDD	V
Logic Supply	IDD	VDD = 3.3V	-	1.6	2.0	mA

※Optimum LCD driving voltage value, referring to above mentioned range, is changed due to different batch of LCD glass.

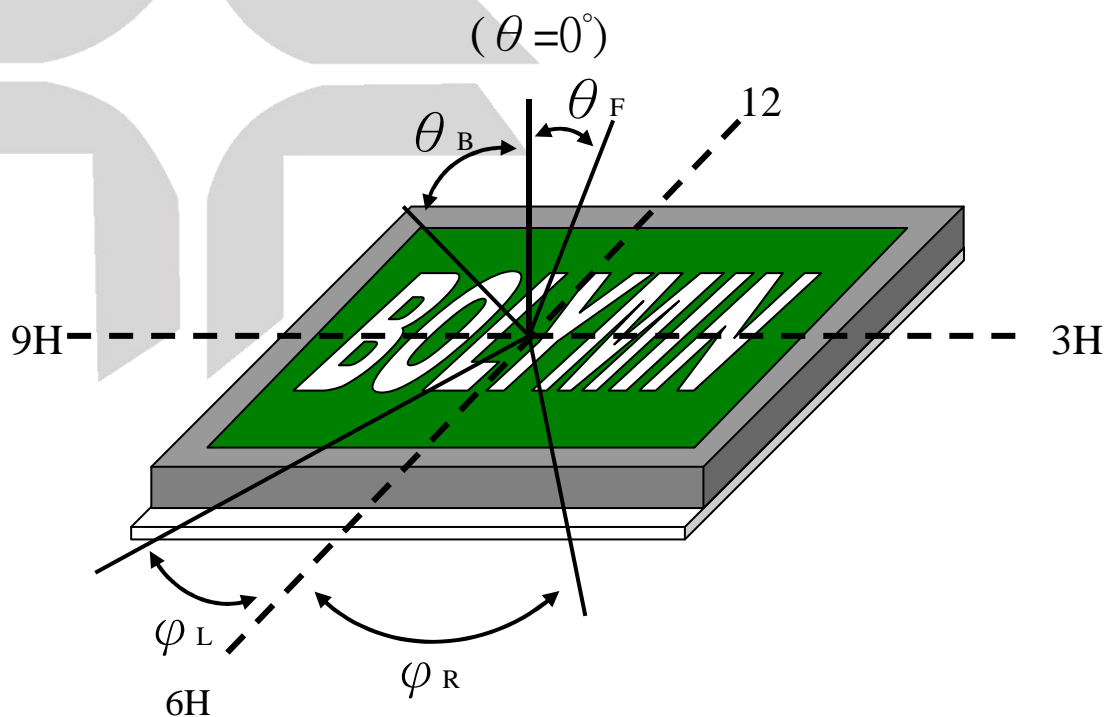


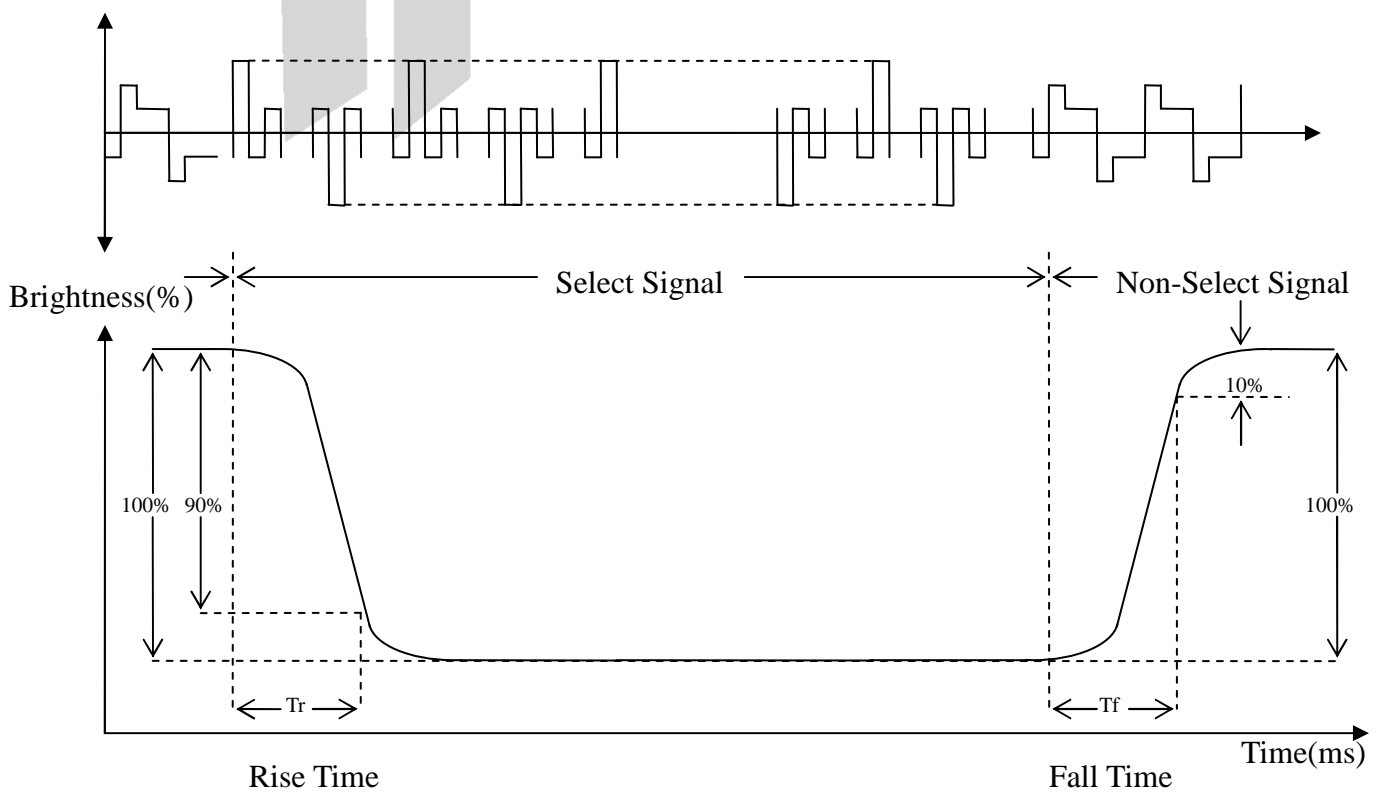
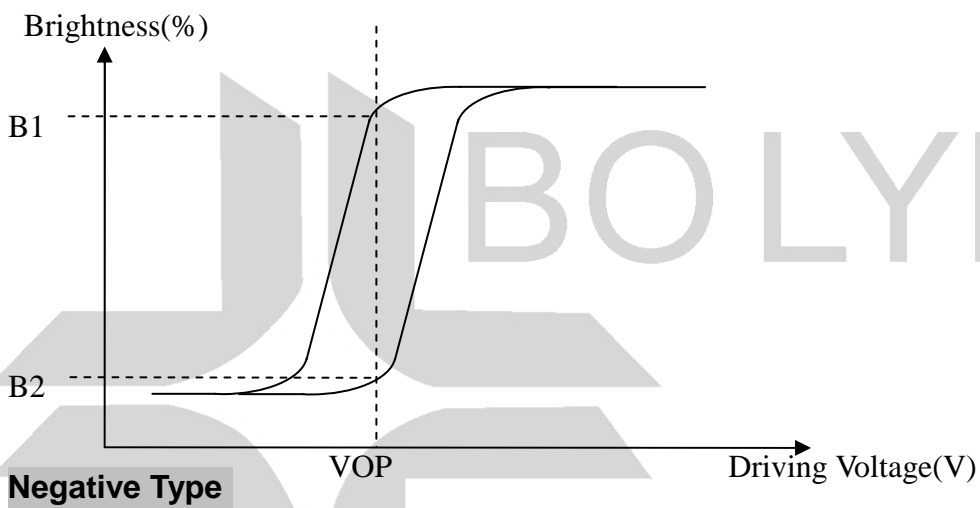
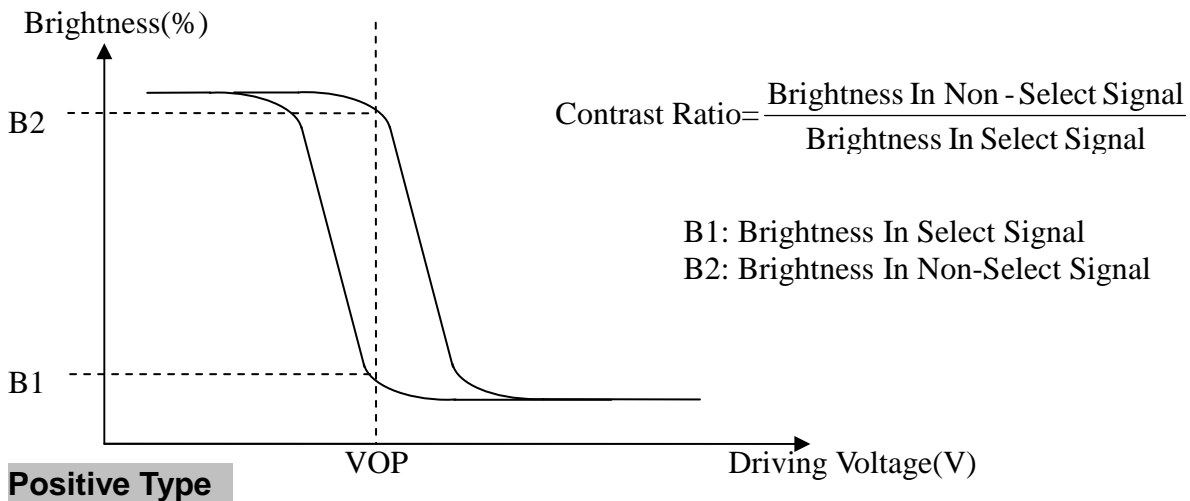
## 6. Optical Characteristics

a. FSTN

(Ta=25°C)

Item	Symbol	Min.	Typ.	Max.	Unit
View Angle (CR>=2)	$\theta_F$	-	30	-	deg
	$\theta_B$	-	40	-	deg
	$\varphi_L$	-	30	-	deg
	$\varphi_R$	-	30	-	deg
Contrast Ratio	CR	-	5	-	-
Response Time 25°C	T rise	-	200	400	ms
	T fall	-	250	400	ms
Frame Frequency	25°C	68	70	72	Hz



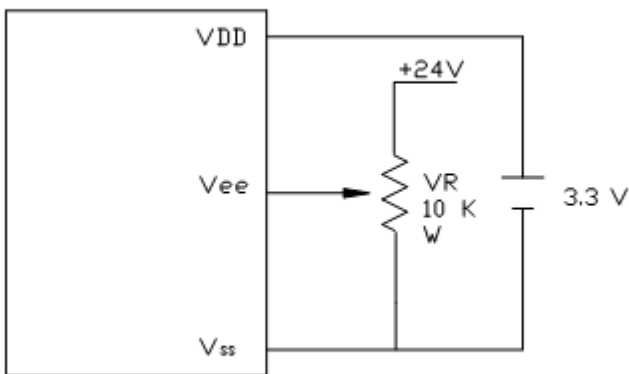


## 7. Interface Pin Function

Pin No.	Signal	Level	Function
1	CL2(CP)	H/L	Data Shift Clock
2	CL1(LP)	H/L	Data Latch Clock
3	FLM	H/L	First Line Marker
4	M	--	Alternate signal
5~8	D0~D3	H/L	Data Input(4 bits)
9	Vee(Vadj)	-	Contrast adjust +16V
10	VDD	-	Power Supply for Logic (+3.3V)
11	VSS	-	Power Supply (GND)
12	EL B/L-ON	-	NC
13	VEL-G	-	Power supply for EL inverter V-
14	VEL	-	Power supply for EL inverter V+

## 8. Power supply for LCD Module and LCD operating voltage adjustment

LCD Module block diagram



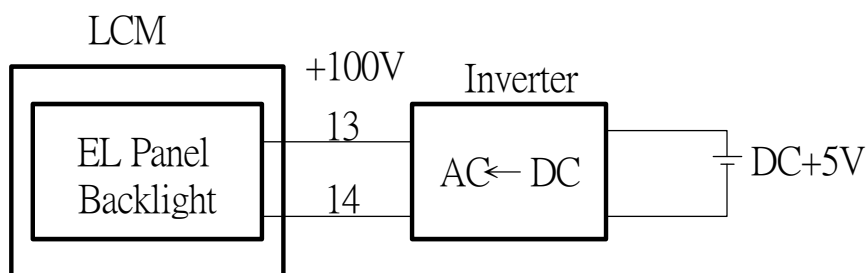
## 9. Backlight information

(1) EL / Blue

Parameter	Symbol	Min	Typ	Max	Unit	Test Condition
Drive Voltage	Vmax	—	100	150	Vrms	25°C
Drive Wave	Fmax	—	400	1000	Hz	25°C
Brightness		60	70	—	cd/m <sup>2</sup>	100V/400Hz
CIE	X	0.16	—	0.22	—	100V/400Hz
	Y	0.41	—	0.49	—	100V/400Hz
Life time		5000			hour	100V/400Hz
Color		Blue			—	Light on 100V/400Hz

(2) Backlight driving methods

a. EL B/L drive from pin13,pin14 directly



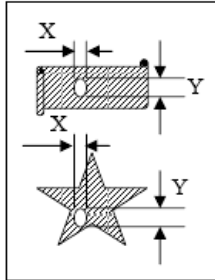
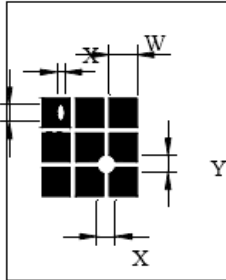
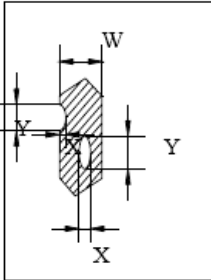
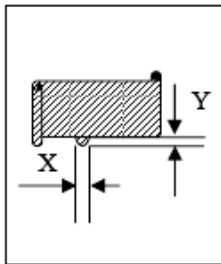
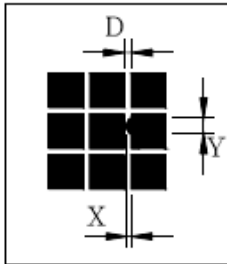
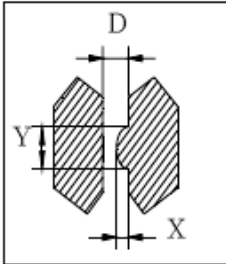
## 10. Quality Assurance

### 10.1 Inspection conditions

1. The LCD shall be inspected under 20~40W white fluorescent light.
2. Checking Direction shall be in the 40 degree from perpendicular line of specimen surface.
3. Checker shall see over 30 cm.
4. Inspect about 5 seconds for each side.
5. Defect that is located at outside of VA and doesn't affect function is ignored.

### 10.2 Inspection Parameters

NO.	Parameter	Criteria																										
1	Black or White spots (Particle)	<table><tr><th colspan="2">Zone Dimension \</th><th rowspan="2">Acceptable Number</th><th rowspan="2">Class Of Defects</th><th rowspan="2">Acceptable Level</th></tr><tr><th>D ≤ 0.10</th><td>Disregard</td></tr><tr><td>0.10 &lt; D ≤ 0.2</td><td>4</td><td rowspan="3">Minor</td><td rowspan="3">2.5</td></tr><tr><td>0.2 &lt; D ≤ 0.3</td><td>2</td></tr><tr><td>0.3 &lt; D</td><td>0</td></tr></table>				Zone Dimension \		Acceptable Number	Class Of Defects	Acceptable Level	D ≤ 0.10	Disregard	0.10 < D ≤ 0.2	4	Minor	2.5	0.2 < D ≤ 0.3	2	0.3 < D	0								
		Zone Dimension \		Acceptable Number	Class Of Defects	Acceptable Level																						
		D ≤ 0.10	Disregard																									
		0.10 < D ≤ 0.2	4	Minor	2.5																							
		0.2 < D ≤ 0.3	2																									
0.3 < D	0																											
D=(Long + Short)/2																												
Total defects should not exceed 5/module																												
Defect that is located at outside of AA and doesn't affect function is ignored.																												
2	Scratch, Substances	<table><tr><th colspan="2">Zone</th><th rowspan="2">Acceptable Number</th><th rowspan="2">Class Of Defects</th><th rowspan="2">Acceptable Level</th></tr><tr><th>X(mm)</th><th>Y(mm)</th></tr><tr><td>—</td><td>0.05 ≥ W</td><td>Disregard</td><td rowspan="3">Minor</td><td rowspan="3">2.5</td></tr><tr><td>4.0 ≥ L</td><td>0.05 ≥ W</td><td>4</td></tr><tr><td>3.0 ≥ L</td><td>0.1 ≥ W</td><td>2</td></tr><tr><td>—</td><td>0.1 &lt; W</td><td>0</td><td></td><td></td></tr></table>				Zone		Acceptable Number	Class Of Defects	Acceptable Level	X(mm)	Y(mm)	—	0.05 ≥ W	Disregard	Minor	2.5	4.0 ≥ L	0.05 ≥ W	4	3.0 ≥ L	0.1 ≥ W	2	—	0.1 < W	0		
		Zone		Acceptable Number	Class Of Defects	Acceptable Level																						
		X(mm)	Y(mm)																									
		—	0.05 ≥ W	Disregard	Minor	2.5																						
		4.0 ≥ L	0.05 ≥ W	4																								
3.0 ≥ L	0.1 ≥ W	2																										
—	0.1 < W	0																										
X: Length    Y: Width																												
Total defects should not exceed 5/module																												
Defect that is located at outside of AA and doesn't affect function is ignored.																												

3	Air Bubbles ( between glass & polarizer)	<table><tr><th>Zone Dimension</th><th>Acceptable Number</th><th>Class Of Defects</th><th>Acceptable Level</th></tr><tr><td><math>D \leq 0.2</math></td><td>Disregard</td><td rowspan="3">Minor</td><td rowspan="3">2.5</td></tr><tr><td><math>0.2 &lt; D \leq 0.5</math></td><td>3</td></tr><tr><td><math>0.5 &lt; D</math></td><td>0</td></tr></table> <p>Total defects shall not excess 3/module. Defect that is located at outside of AA and doesn't affect function is ignored. Bobbie is sawn only under reflection light is disregarded.</p>	Zone Dimension	Acceptable Number	Class Of Defects	Acceptable Level	$D \leq 0.2$	Disregard	Minor	2.5	$0.2 < D \leq 0.5$	3	$0.5 < D$	0														
Zone Dimension	Acceptable Number	Class Of Defects	Acceptable Level																									
$D \leq 0.2$	Disregard	Minor	2.5																									
$0.2 < D \leq 0.5$	3																											
$0.5 < D$	0																											
4	Displaying Pattern	<p>1. Incomplete or broken line is not allowed. 2. Pinholes</p> <table><tr><th>Dimension <math>\Phi</math>(mm)</th><th>Criteria</th><th>Class Of Defects</th><th>Acceptable Level</th></tr><tr><td><math>\Phi &lt; 0.1</math></td><td>Disregard</td><td rowspan="4">Minor</td><td rowspan="4">2.5</td></tr><tr><td><math>0.1 &lt; \Phi \leq 0.2</math></td><td>2</td></tr><tr><td><math>0.2 &lt; \Phi \leq 0.25</math></td><td>1</td></tr><tr><td><math>0.25 &lt; \Phi</math></td><td>0</td></tr></table> <div></div> <p><math>\varnothing = (X+Y)/2</math></p> <p>3. Deformation</p> <table><tr><th>Dimension <math>\Phi</math>(mm)</th><th>Criteria</th><th>Class Of Defects</th><th>Acceptable Level</th></tr><tr><td><math>\Phi &lt; 0.15</math></td><td>Disregard</td><td rowspan="3">Minor</td><td rowspan="3">2.5</td></tr><tr><td><math>\Phi \leq 0.25</math> and <math>X \leq 1/2D</math></td><td>3</td></tr><tr><td><math>\Phi &gt; 0.25</math> and <math>X &gt; 1/2D</math></td><td>0</td></tr></table> <div></div> <p>D : 間距                      <math>\varnothing = (X+Y)/2</math></p>	Dimension $\Phi$ (mm)	Criteria	Class Of Defects	Acceptable Level	$\Phi < 0.1$	Disregard	Minor	2.5	$0.1 < \Phi \leq 0.2$	2	$0.2 < \Phi \leq 0.25$	1	$0.25 < \Phi$	0	Dimension $\Phi$ (mm)	Criteria	Class Of Defects	Acceptable Level	$\Phi < 0.15$	Disregard	Minor	2.5	$\Phi \leq 0.25$ and $X \leq 1/2D$	3	$\Phi > 0.25$ and $X > 1/2D$	0
Dimension $\Phi$ (mm)	Criteria	Class Of Defects	Acceptable Level																									
$\Phi < 0.1$	Disregard	Minor	2.5																									
$0.1 < \Phi \leq 0.2$	2																											
$0.2 < \Phi \leq 0.25$	1																											
$0.25 < \Phi$	0																											
Dimension $\Phi$ (mm)	Criteria	Class Of Defects	Acceptable Level																									
$\Phi < 0.15$	Disregard	Minor	2.5																									
$\Phi \leq 0.25$ and $X \leq 1/2D$	3																											
$\Phi > 0.25$ and $X > 1/2D$	0																											

Other Inspection standard reference Bolymin standard.



## 11. Reliability

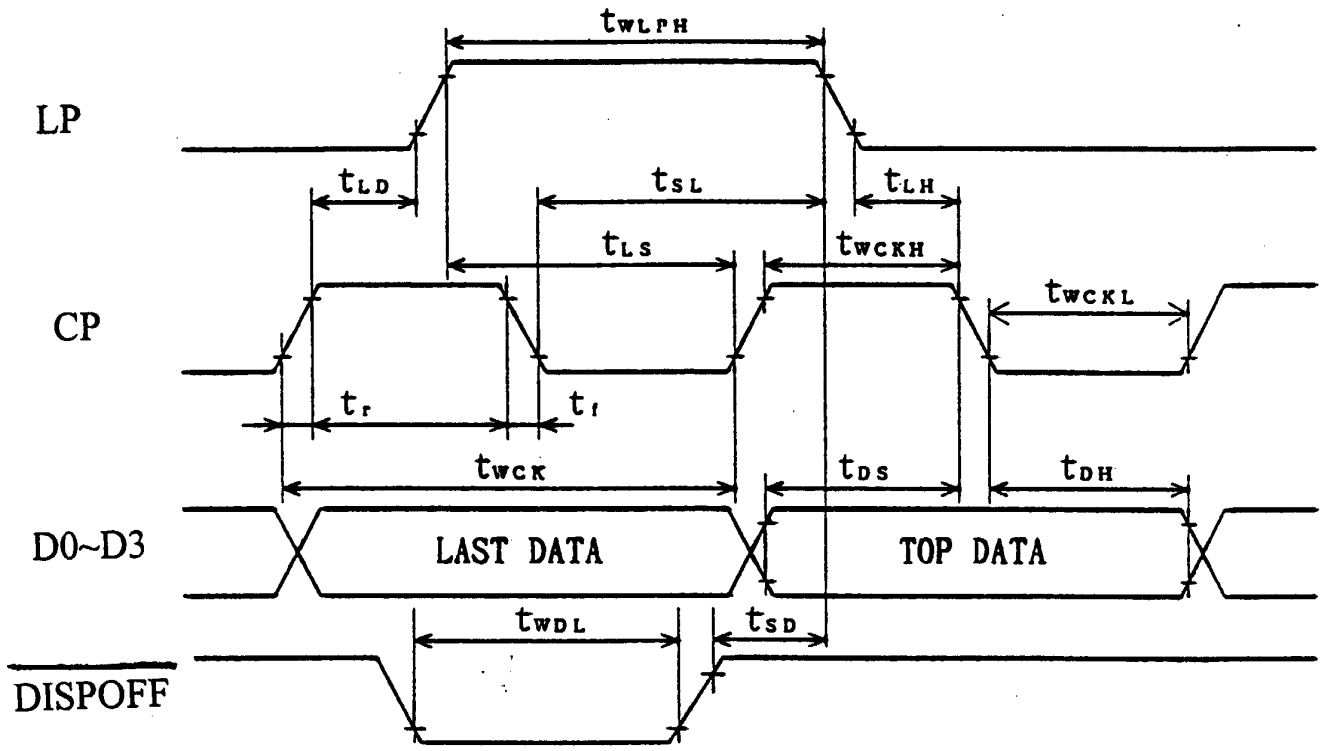
### ■Content of Reliability Test

Environmental Test				
No	Test Item	Content of Test	Test Condition	Applicable Standard
1	High Temperature storage	Endurance test applying the high storage temperature for a long time.	80℃ 96 hrs	—
2	Low Temperature storage	Endurance test applying the high storage temperature for a long time.	-30℃ 96 hrs	—
3	High Temperature Operation	Endurance test applying the electric stress (Voltage & Current) and the thermal stress to the element for a long time.	70℃ 96 hrs	—
4	Low Temperature Operation	Endurance test applying the electric stress under low temperature for a long time.	-20℃ 96 hrs	—
5	Humidity Test	Endurance test applying the high humidity storage for a long time.	40℃,90%RH 96hrs	—
6	Temperature cycle (Non-operation)	Endurance test applying the low and high temperature cycle. 	-30℃/80℃ 10 cycles	—
7	Vibration test	Endurance test applying the vibration during transportation and using.	Total Fixed Amplitude:1.5mm Vibration Frequency :10~55Hz One cycle 60 seconds to 3 direction of X,Y,Z for each 15minutes	—

※Assess after placing at normal temperature and humidity for 4 hour ◦ No abnormalities in functions and appearance ◦



## 12.2 Timing characteristics



VDD = 4.5V to 5.5V

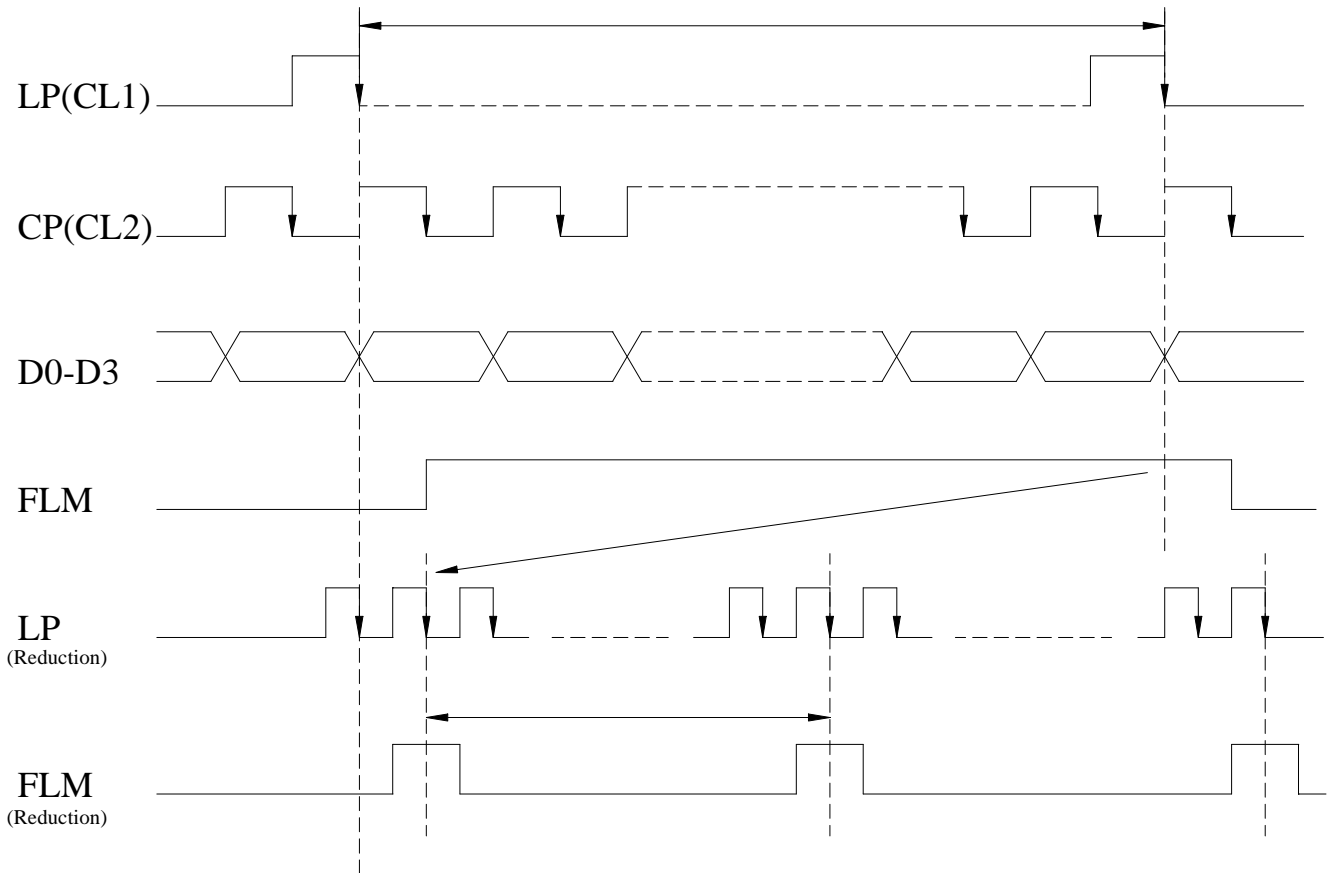
Parameter	Symbol	Condition	Min	Max	Unit
Shift Clock Period	$t_{wck}$	$T_r, T_f \leq 10\text{ns}$	50	-	ns
Clock Width "H" Pulse Width	$t_{wckH}$	-	15	-	ns
Clock Width "L" Pulse Width	$t_{wckL}$	-	15	-	ns
Data Set Up Time	$t_{ds}$	-	10	-	ns
Data Hold Time	$t_{dH}$	-	12	-	ns
Latch Pulse "H" Pulse Width	$t_{wLPH}$	-	15	-	ns
Shift Clock to Latch Pulse Rise Time	$t_{LD}$	-	0	-	ns
Shift Clock to Latch Pulse Fall Time	$t_{SL}$	-	30	-	ns
Latch Pulse to Shift Clock Rise Time	$t_{LS}$	-	25	-	ns
Latch Pulse to Shift Clock Fall Time	$t_{LH}$	-	25	-	ns
Input Signal Rise/Fall Time	$t_r, t_f$	-	-	50	ns
/DISPOFF Removal Time	$t_{SD}$	-	100	-	ns
/DISPOFF "L" Pulse Width	$t_{wDL}$	-	1.2	-	ns

VDD = 3.0V to 4.5V

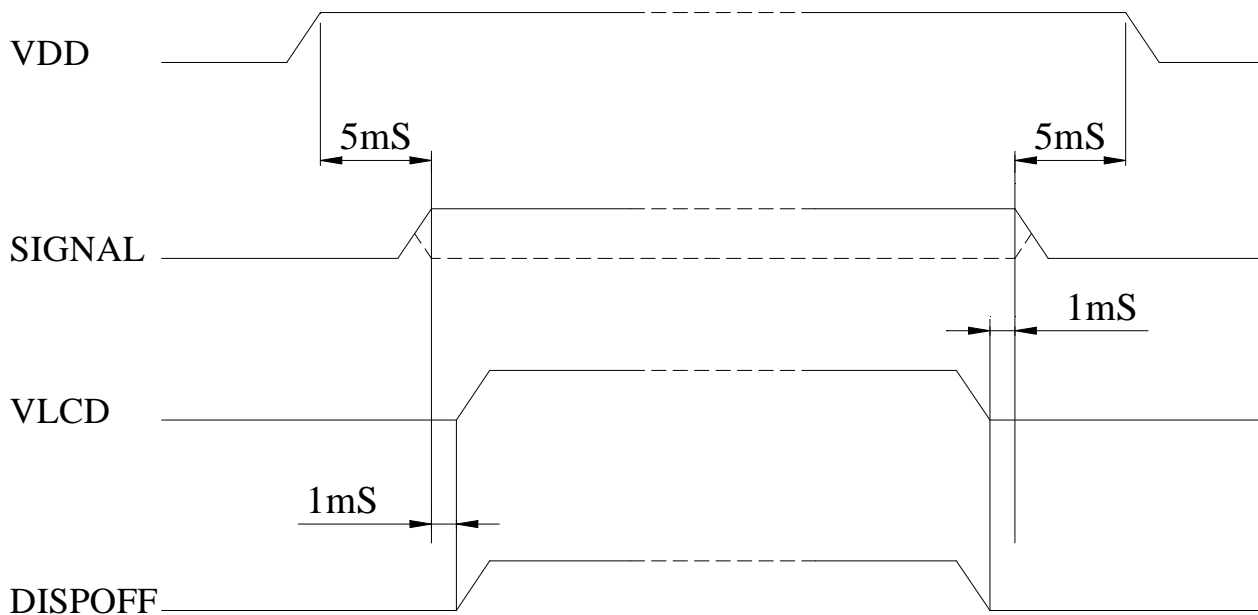
Parameter	Symbol	Condition	Min	Max	Unit
Shift Clock Period	twck	Tr, Tf ≤ 10ns	66	-	ns
Clock Width “H” Pulse Width	twckH	-	23	-	ns
Clock Width “L” Pulse Width	twckL	-	23	-	ns
Data Set Up Time	tds	-	15	-	ns
Data Hold Time	tdh	-	23	-	ns
Latch Pulse “H” Pulse Width	twlPH	-	30	-	ns
Shift Clock to Latch Pulse Rise Time	tLD	-	0	-	ns
Shift Clock to Latch Pulse Fall Time	tSL	-	50	-	ns
Latch Pulse to Shift Clock Rise Time	tLS	-	30	-	ns
Latch Pulse to Shift Clock Fall Time	tLH	-	30	-	ns
Input Signal Rise/Fall Time	tr,tf	-	-	50	ns
/DISPOFF Removal Time	tSD	-	100	-	ns
/DISPOFF “L” Pulse Width	twDL	-	1.2	-	ns

## 12.2.1 Controller Interface Timing Chart

### TIMING CHART OF INPUT SIGNAL



### POWER ON/OFF TIMING



## 12.2.2 Display Data Format (default)

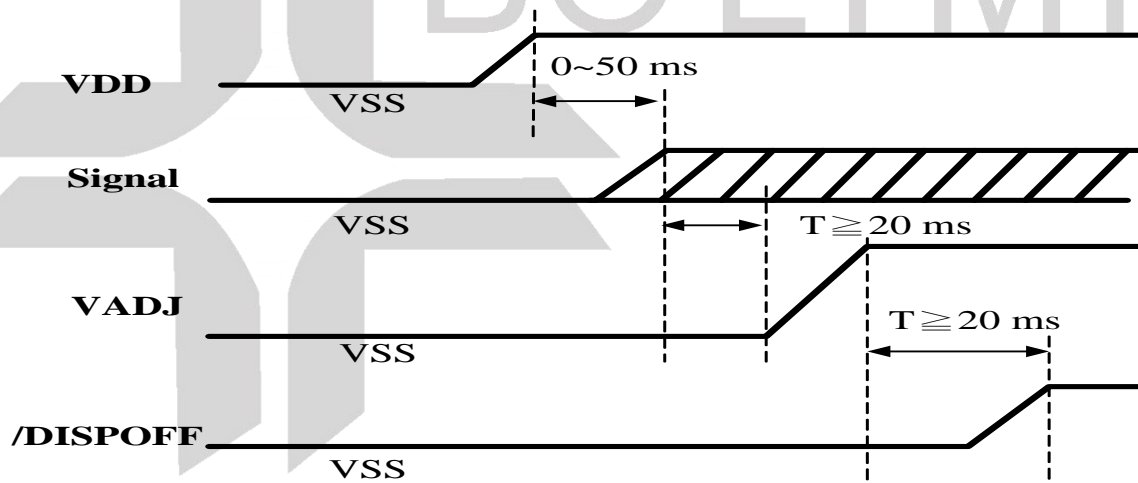
SEG1											SEG320				
#1	D3	D2	D1	D0	D3	D2			-			D3	D2	D1	D0
#2	D3	D2	D1	D0	D3	D2						D3	D2	D1	D0
#240															
	D3	D2	D1	D0	D3	D2						D3	D2	D1	D0

Landscape Display Type(Top View)

## 12.2.3 Power ON/OFF Sequence

Please maintain the blow sequence when turning on and off the power supply of the module. If /DISPOFF is supplied to the module while internal alter signal for LCD driving (M) is unstable, DC component will be supplied to the LCD panel. This may cause damage the LCD module.

### POWER ON SEQUENCE



### POWER OFF SEQUENCE

