BOLYMIN

SPECIFICATIONS FOR LCD MODULE

RoHS COMPLIANT

MODEL NO.
BG240128GFPHBn87a$
VER.03

FOR MESSRS:

_____

ON DATE OF:

_____

APPROVED BY:

_____

History of Version

Version	Contents	Date	Note
01	NEW VERSION	2008/06/16	SPEC.
02	Add Handling Instruction, update Electrical Characteristics, quality Assurance and Reliability	2013/05/28	Page 5、8、13 15
03	Update Handling Instruction, quality assurance and reliability.	2021/6/11	Page 5,13,14

C O N T E N T S

1. Numbering System

B	G	240128 G	F	P	H	_	B	n87a$
0	1	2	3	4	5	6	7	8	9

0	Brand	Bolymin	
1	Module Type	C= character type G= graphic type P= TAB/TCP type	O= COG type F= COF type L=PLED/OLED
2	Format	2002=20 characters, 2 lines 12232= 122 x 32 dots	
3	Version No.	A type	
4	LCD Color	G=STN/gray Y=STN/yellow-green PLED/yellow-green C=color STN,OLED/RGB	B=STN/blue,OLED/blue F=FSTN T=TN
5	LCD Type	R=positive/reflective P=positive/transflective	M=positive/transmissive N=negative/transmissive
6	Backlight type/color	L=LED array/ yellow-green H=LED edge/white R=LED array/red G=LED edge/yellow-green F=RGB array I=RGB edge Q=LED edge/red N=No backlight	D=LED edge/blue E=EL/white B=EL/blue C=CCFL/white Y=LED Bottom/yellow O=LED array/orange K=LED edge/green A=LED edge/amber
7	CGRAM Font (applied only on character type)	J=English/Japanese Font E=English/European Font G=Chinese(simple) F=Chinese(traditional)	C=English/Cyrillic Font H=English/Hebrew Font A=English/Arabic Font
8	View Angle/ Operating Temperature	B=Bottom/Normal Temperature H=Bottom/Wide Temperature U=Bottom/Ultra wide Temperature	T=Top/Normal Temperature W=Top/Wide Temperature C=9H/Normal Temperature E=Top/ultra wide temperature
9	Special Code	3=3.3 volt logic power supply n=negative voltage for LCD c=cable/connector xxx=to be assigned on datasheet 87a= Controller IC=RAIO8835	t=temperature compensation for LCD p=touch panel $=RoHS

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℃±10℃ 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℃ 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℃±10℃.
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℃) 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℃) 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.

2.6 MTBF

2.6.1 .By specific test condition, MTBF based on 30℃ normal operation temperature is 50,000hours.

2.6.2 Test Condition:

2.6.2.1 Supply Voltage for LCM: Typical Vdd

2.6.2.2 CC (Constant Current) mode and typical current is applied for LED.

2.6.2.3 Run-Patterns: by Bolymin's test program that has defined patterns and cyclic period.

2.6.2.4 Humidity: 60%RH

2.6.3 Test Criteria:

Attenuation of average brightness: $\leqq$ 50%

Increasing of current consumption for LCM/Backlight: $\leqq$ 20%

Display function at room temperature: Normal

Appearance: Normal

3. General Specification

(1) Mechanical Dimension

Item	Standard Value	Unit
Number of dots	240 x 128	dots
Module dimension (L x W x H)	170.0 x 103.5 x 14.0	mm
View area	128.0 x 74.0	mm
Active area	120.0 x 64.0	mm
Dot size	0.47x 0.47	mm
Dot pitch	0.5 x 0.5	mm

(2) Controller IC: RAIO8835

4. Absolute Maximum Rating

4.1 Electrical Absolute Maximum Ratings

(Vss=0V, Ta=25℃)

Item	Symbol	Min	Typ	Max	Unit
Input Voltage	V_I	-0.3	—	Vdd+0.3	V
Supply Voltage For Logic	Vdd-Vss	0.3	—	+7	V
Supply Voltage For LCD	Vdd-Vo	0.3	—	28	V

4.2 Environmental Absolute Maximum Ratings

Item	Symbol	Min	Max	Unit	Note
Operating Temperature	TOP	0	50	℃	(1)
Storage Temperature	TST	-10	60	℃	(1)、(2)

Note (1)

(a) 90 %RH Max. (Ta <= 40 ℃).

(b) Wet-bulb temperature should be 39 ℃ Max. (Ta > 40 ℃).

(c) No condensation.

Note (2) The temperature of panel surface should be 0 ℃ min. and 50 ℃ max.
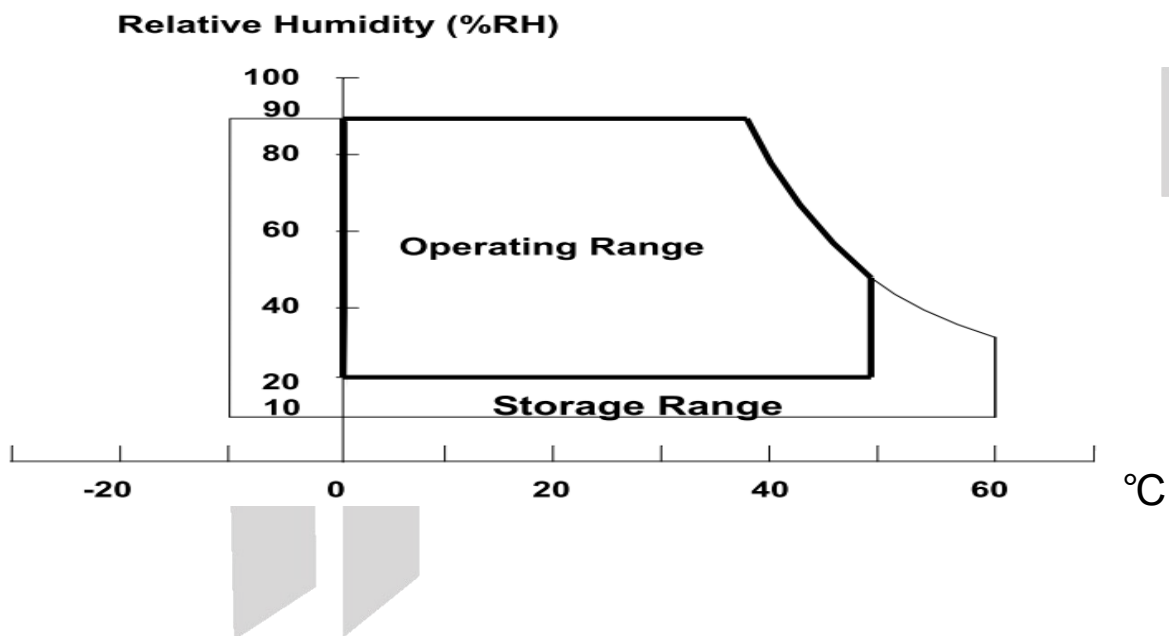
5. Electrical Characteristics

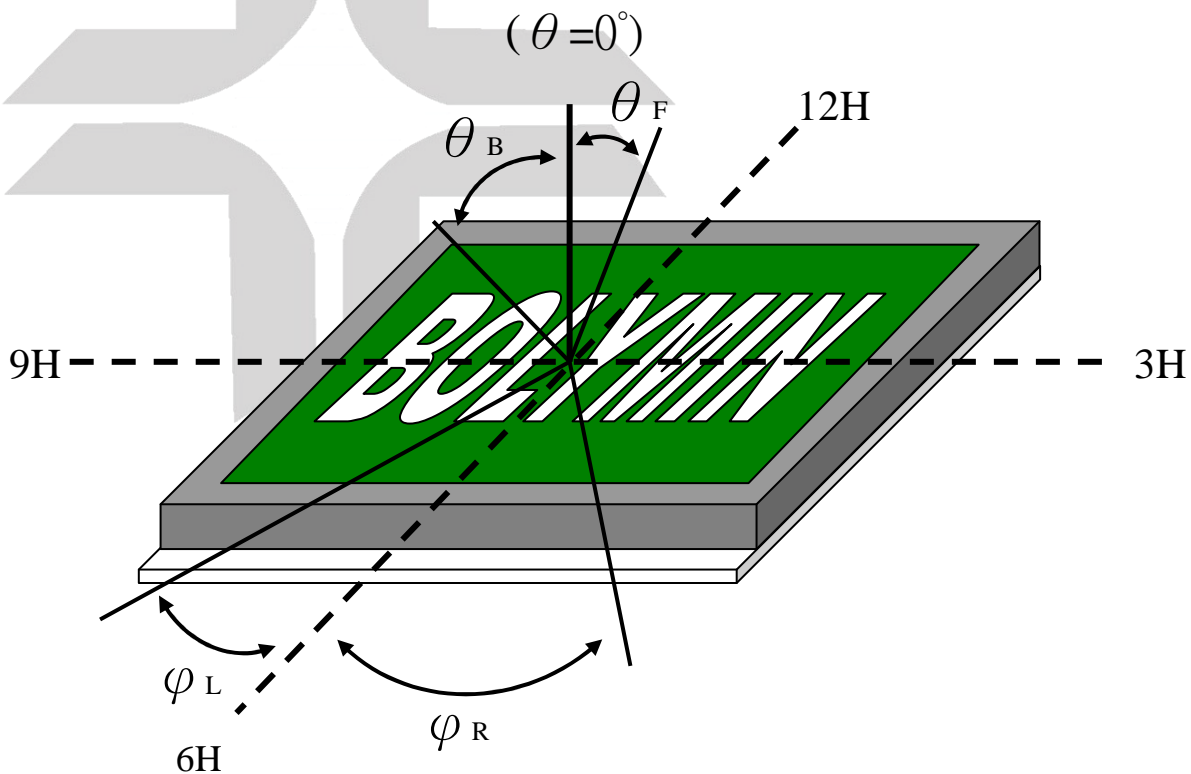| Item	Symbol	Condition	Min.	Typ.	Max.	Unit
Supply Voltage For Logic	Vdd-Vss	—	4.75	—	5.25	V
Supply Voltage For LCD	Vdd-V0	Ta=25℃	18.5	18.8	19.1	V
Input High Vol	V_{IH}	—	2.2	—	Vdd	V
Input Low Vol	V_{IL}	—	0	—	0.8	V
Output High Vol	V_{OH}	—	2.4	—	Vdd	V
Output Low Vol.	V_{OL}	—	0	—	0.4	V
Supply Current	Idd	Vdd=5V	—	50	—	mA
LCM Surface Luminance Ta=25℃	L	I_{LED}=240mA Display all OFF	100	150	—	cd/m^2

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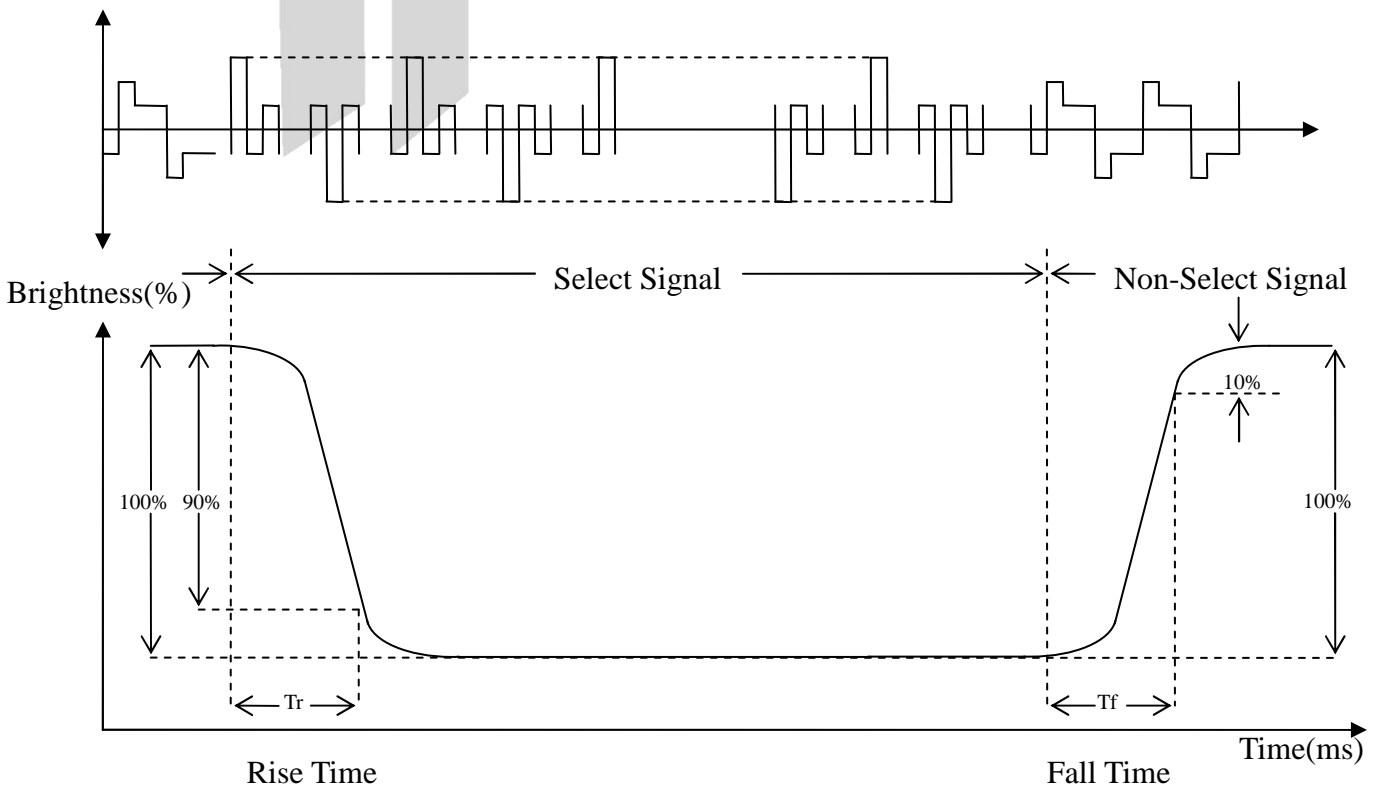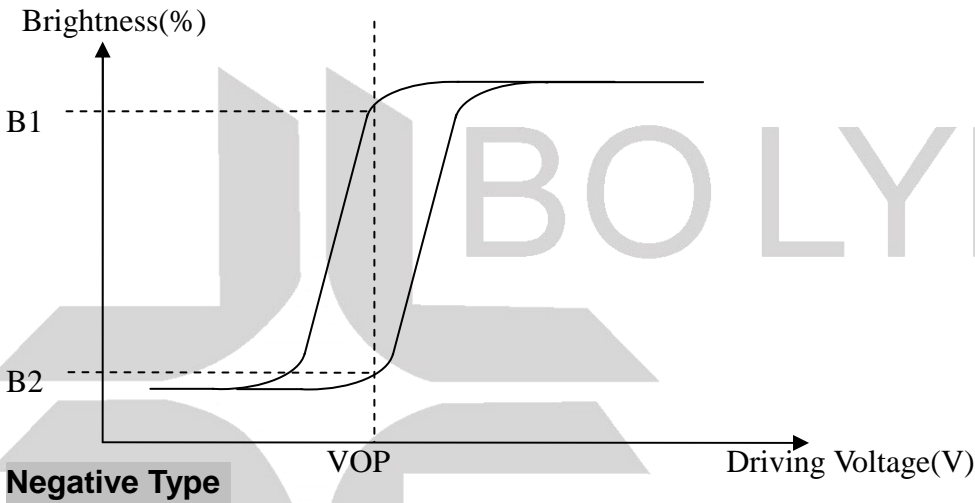
6. Optical Characteristics
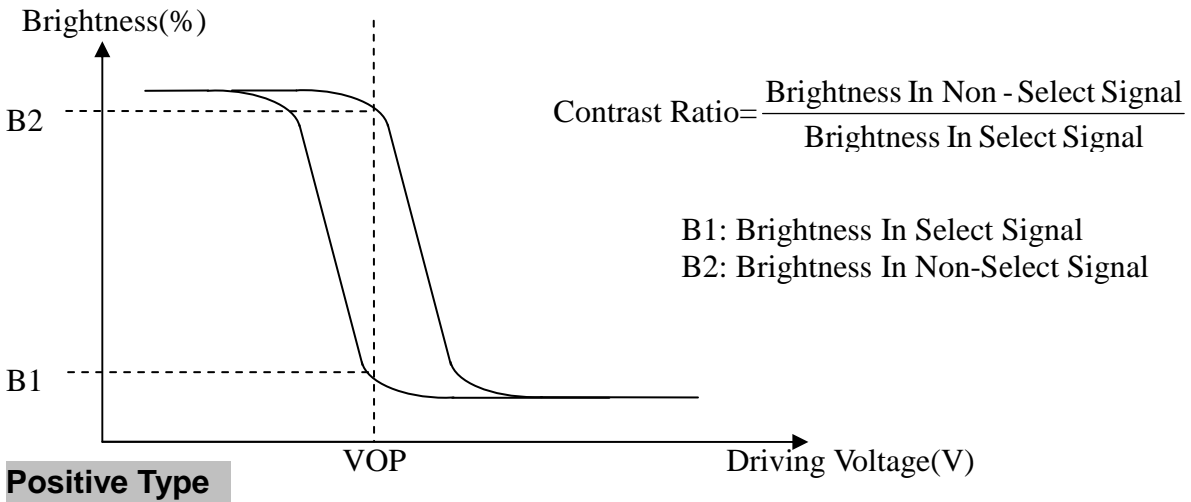
a. FSTN

Item	Symbol	Min.	Typ.	Max.	Unit
View Angle (CR>=2)	θ_F	-	36	-	deg
	θ_B	-	38	-	deg
	φ_L	-	40	-	deg
	φ_R	-	45	-	deg
Contrast Ratio	CR	-	5	-	-
Response Time 25℃	T rise	-	200	400	ms
	T fall	-	250	400	ms

$(\theta = 0^{\circ})$

θ_F 12H

θ_B

9H 3H

φ_L

φ_R

6H

Brightness(%)

B2

B1

VOP

Driving Voltage(V)

Positive Type

$$\text{Contrast Ratio} = \frac{\text{Brightness In Non - Select Signal}}{\text{Brightness In Select Signal}}$$

B1: Brightness In Select Signal
B2: Brightness In Non-Select Signal

Brightness(%)

B1

B2

VOP

Driving Voltage(V)

Negative Type

BOLYMIN

Brightness(%)

Select Signal

Non-Select Signal

10%

100% 90%

100%

Tr

Tf

Rise Time

Fall Time

Time(ms)

7. Interface Pin Function

Pin No.	Symbol	Level	Description
1	/RES	H / L	Reset signal
2	/RD	H / L	8080 family: Read signal, 6800 family: Enable clock
3	/WR	H / L	8080 family: Write signal, 6800 family: R/W signal
4	SEL2	L	8080 or 6800 interface select
5	SEL1	H / L	H:6800 ,L:8080
6	/CS	H / L	Chip select , Active L
7	A0	H / L	RD=L WR=H ,A0=L :Data Read AO=H :Status read RD=H WR=L ,A0=L :Data Write AO=H :Command write
8	DB0	H / L	Data bus line
9	DB1	H / L	Data bus line
10	DB2	H / L	Data bus line
11	DB3	H / L	Data bus line
12	DB4	H / L	Data bus line
13	DB5	H / L	Data bus line
14	DB6	H / L	Data bus line
15	DB7	H / L	Data bus line
16	VDD	-	Power supply (+5 V)
17	VSS	-	Power supply (GND)
18	V0	-	Contrast adjustment
19	Vee	-	Negative voltage output **–16.0V**
20	FGND	-	Frame GND

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

＊(Option) LCM operating on " DC 5V " input with built-in negative voltage
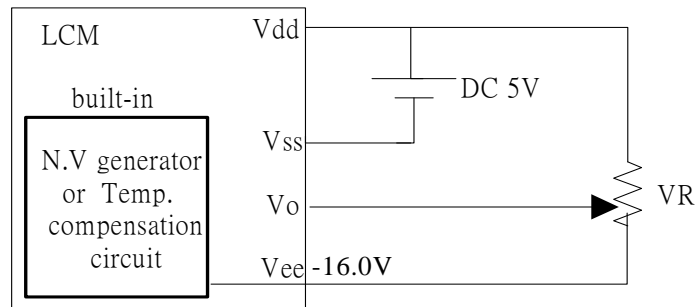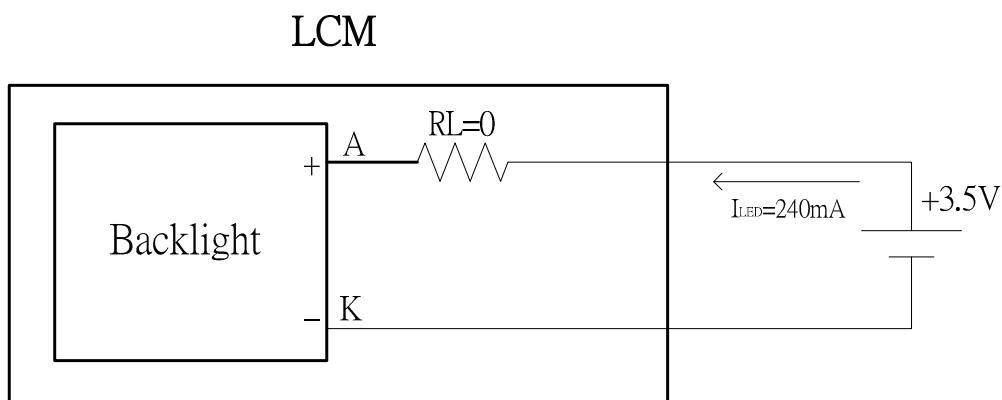

9. Backlight information

9.1 Specification

(1))LED edge/white

Parameter	Symbol	Min	Typ	Max	Unit	Test Condition
Supply Current	ILED	—	240	—	mA	V=3.5V
Supply Voltage	V	3.2	3.5	3.8	V	ILED=240mA
Reverse Voltage	VR	—	—	5	V	—
CIE Chromaticity Diagram	X	0.30	—	0.34	nm	ILED=240mA
	Y	0.28	—	0.34		
Color	White					

9.2 Backlight driving methods

a. LED B/L driven from A.K pin directly
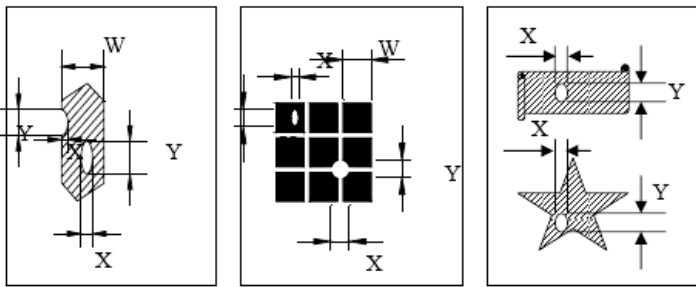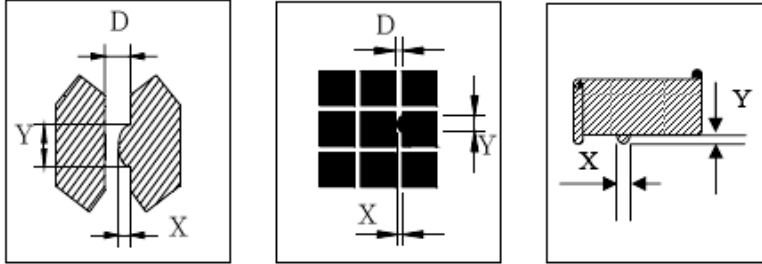
a.1 edge/white

LCM

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><td>Zone Dimension</td><td>Acceptable Number</td><td>Class Of Defects</td><td>Acceptable Level</td></tr><tr><td>D≦0.10</td><td>Disregard</td><td rowspan="4">Minor</td><td rowspan="4">2.5</td></tr><tr><td>0.10＜D≦0.2</td><td>4</td></tr><tr><td>0.2＜D≦0.3</td><td>2</td></tr><tr><td>0.3＜D</td><td>0</td></tr></table> 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><td colspan="2">Zone</td><td>Acceptable Number</td><td>Class Of Defects</td><td>Acceptable Level</td></tr><tr><td>X(mm)</td><td>Y(mm)</td><td></td><td></td><td></td></tr><tr><td>—</td><td>0.05≧W</td><td>Disregard</td><td rowspan="4">Minor</td><td rowspan="4">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＜W</td><td>0</td></tr></table> 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)	Zone / Dimension	Acceptable Number	Class Of Defects	Acceptable Level
		D≦0.2	Disregard	Minor	2.5
		0.2＜D≦0.5	3		
		0.5＜D	0		

Total defects shall not excess 3/module.
Defect that is located at outside of AA and doesn't affect function is ignored.
Bobble is sawn only under reflection light is disregarded.

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4 | Displaying Pattern

1. Incomplete or broken line is not allowed.
2. Pinholes

Dimension Φ(mm)	Criteria	Class Of Defects	Acceptable Level
Φ＜0.1	Disregard	Minor	2.5
0.1＜Φ≦0.2	2		
0.2＜Φ≦0.25	1		
0.25＜Φ	0		

$\emptyset = (X+Y)/2$

3. Deformation

Dimension Φ(mm)	Criteria	Class Of Defects	Acceptable Level
Φ＜0.15	Disregard	Minor	2.5
Φ≦0.25 and X≦1/2D	3		
Φ＞0.25and X＞1/2D	0		

D：間距 $\emptyset = (X+Y)/2$

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.	60℃ 96 hrs	──
2	Low Temperature storage	Endurance test applying the high storage temperature for a long time.	-10℃ 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.	50℃ 96 hrs	──
4	Low Temperature Operation	Endurance test applying the electric stress under low temperature for a long time.	0℃ 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. -10℃ 60℃ ◄─────────► 30min 30min 1 cycle	-10℃/60℃ 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. Appendix (Drawing, Timing Characteristics)

12.1 Drawing

PIN NO.	SYMBOL
1	/RES
2	/RD
3	/WR
4	SEL2
5	SEL1
6	/CS
7	A0
8	DB0
9	DB1
10	DB2
11	DB3
12	DB4
13	DB5
14	DB6
15	DB7
16	VDD
17	VSS
18	Vo
19	Vee
20	FGND

240*128 Dots
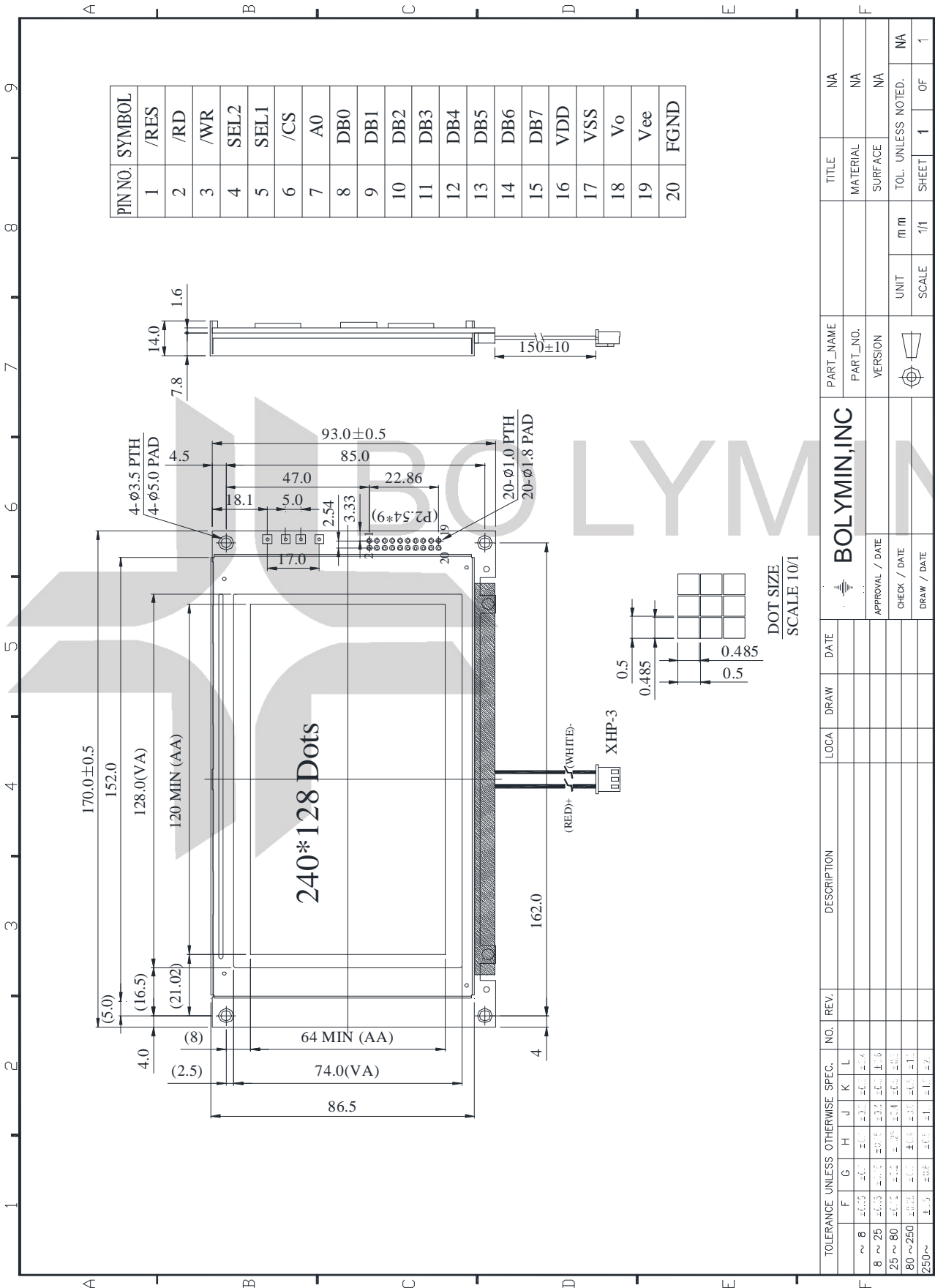
12.2 Timing characteristics

a.8080 Family Interface Timing

Parameter	Condition	Symbol	Min	Max	Unit	Remark
Address Hold Time		tAH8	10		ns	A0,/CS
Address Setup Time		tAW8	0		ns	
System Cycle Time		tCYC	Note		ns	/WR,/RD
Strobe Pulse Width	CL=100 pF	tOC	150		ns	
Data Setup Time	VDD=2.7~4.5	tDS8	120		ns	DB0~DB7
Data Hold Time		tDH8	5		ns	
/RD Access Time		tACC8	-	80	ns	
Output Disable Time		tOH8	10	55	ns	

Note: For memory control and system control commands:
tCYC8=2tC+tOC+tCEA+75 > tACV +245
For all other commands:
tCYC8=4tC+tOC+30
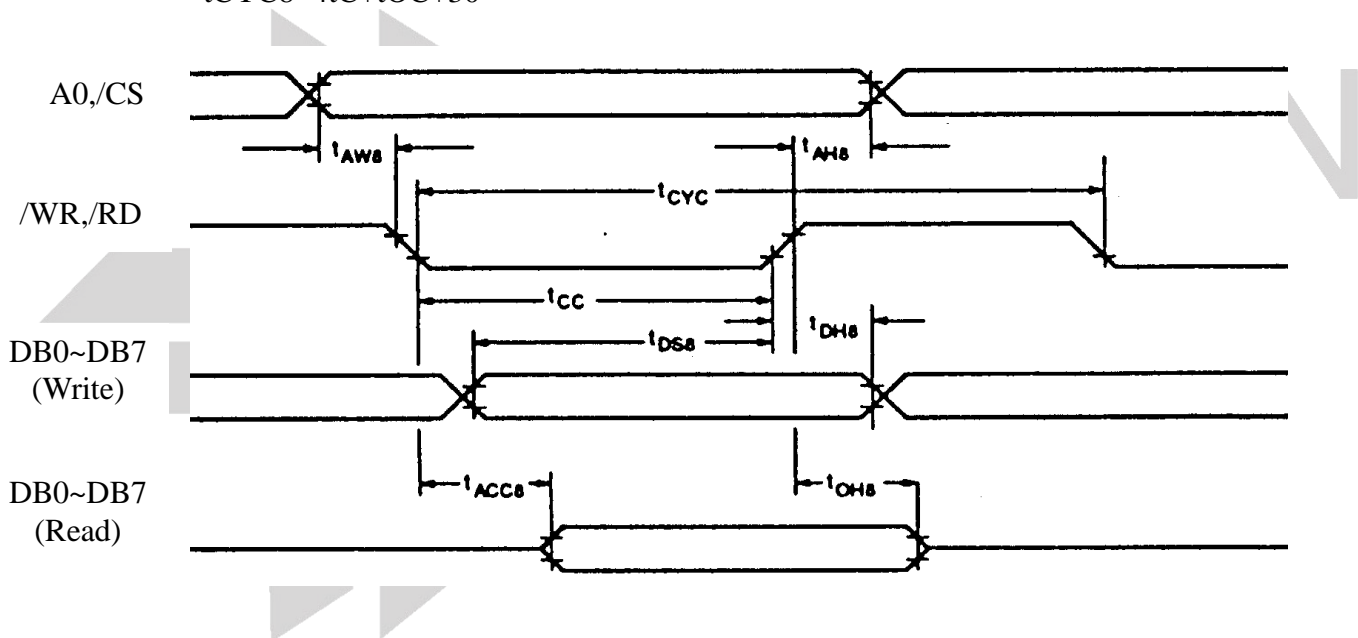
b. 6800 Family Interface Timing

Parameter	Condition	Symbol	Min	Max	Unit	Remark
System Cycle Time		tCYC6	Note		ns	A0,/CS, R/W
Address Setup Time		tAW6	10		ns	
Address Hold Time		tAH6	0		ns	
Data Setup Time	CL=100 pF VDD=2.7~4.5	tDS6	120		ns	DB0~DB7
Data Hold Time		tDH6	0		ns	
Output Disable Time		tOH6	10	75	ns	
Access Time		tACC6	-	130	ns	
Enable Pulse width		tEW	150	-	ns	E

Note: For memory control and system control commands:
$tCYC6=2tC+tEW+tCEA+75 > tACV +245$
For all other commands:
$tCYC6=4tC+tEW+30$
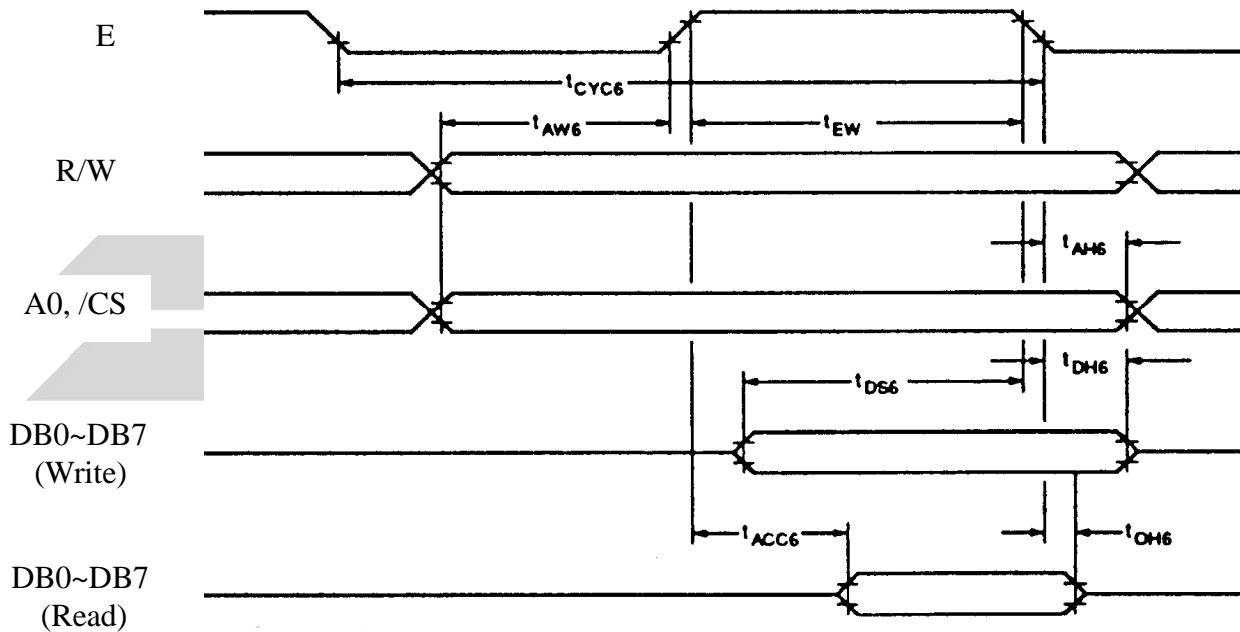
AC Electrical Characteristics

12.4 RAIO8835 controller

Instruction Set

Class	Command	Code											Hex	Command Description	Command read parameters
		/RD	/WR	A0	D7	D6	D5	D4	D3	D2	D1	D0			Number of bytes
System Control	SYSTEM SET	1	0	1	0	1	0	0	0	0	0	0	40	Initialized Device and display	8
	SLEEP IN	1	0	1	0	1	0	1	0	0	1	1	53	Enter Standby mode	0
Display Control	DISP ON/OFF	1	0	1	0	1	0	1	1	0	0	D	58, 59	Enable and disable display and display flashing	1
	SCROLL	1	0	1	0	1	0	0	0	1	0	0	44	set Display start address and display regions	10
	CSRFORM	1	0	1	0	1	0	1	1	1	0	1	5D	Set cursor byte	2
	CGRAM ADDR.	1	0	1	0	1	0	1	1	1	0	0	5C	Set start address of character generator RAM	2
	CSRDIR	1	0	1	0	1	0	0	1	1	CD1	CD0	4C to 4F	Set direction of cursor movement	0
	HDOT SCR	1	0	1	0	1	0	1	1		1	0	5A	set horizontal scroll position	1
	OVLAY	1	0	1	0	1	0	1	1	0	1	1	5B	set display overlay format	1
Drawing Control	CSRW	1	0	1	0	1	0	0	0	1	1	0	46	set cursor address	2
	CSRR	1	0	1	0	1	0	0	0	1	1	1	47	read cursor address	2
Memory Control	MWRITE	1	0	1	0	1	0	0	0	0	1	0	42	write to display memory	-
	MREAD	1	0	1	0	1	0	0	0	0	1	1	43	read from display memory	-

Note:

1. In general, the internal registers of the RAIO8835 are modified as each command parameter is input. However, the microprocessor does not have to set all the parameters of a command and may send a new command before all parameters have been input. The internal registers for the parameters that have been input will have been changed but the remaining parameter registers are unchanged.

   2 bytes parameters (where two bytes are treated as 1 data item) are handled as following:
   a. CSRW, CSRR: Each byte is processed individually. The microprocessor may read or write just the low byte of the cursor address.
   b. SYSTEM SET, SCROLL, CGRAM ADR. : Both parameter bytes are processed together. If the command is changed after half of the parameter has been input, the single byte is ignored.

2. APL and APH are 2-byte parameters, but are treated as two 1-byte parameters.

3. Please refer to RAIO8835 LCD Controller Data Book for detail.