BOLYMIN

SPECIFICATIONS FOR LCD MODULE

RoHS COMPLIANT

MODEL NO.
BG12864EFNHWn$
VER.01

FOR MESSRS:

_____

ON DATE OF:

_____

APPROVED BY:

_____

History of Version

Version	Contents	Date	Note
01	**NEW VERSION**	2014/06/03	SPEC.

C O N T E N T S

1. Numbering System

B	G	12864	E	F	N	H	-	W	n$
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 207d=AVANT IC	t=temperature compensation for LCD p=touch panel $=RoHS

2. Handling Instruction
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 on the surface of display area.

2.1.2. The polarizer used on the display surface is easily scratched and damaged. Extreme care should be taken when handling. 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 and never scrub hard.

2.1.3. Store the panel or module in a dark place where the temperature is 20℃±5℃ and the humidity is below 60% RH.

2.1.4. Keep LCD panels away from direct sunlight, also avoid them in high-temperature & high humidity environment for a long period.

2.1.5. Do not input any signal before power is turned on.

2.1.6. 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.

2.1.7. To control temperature and time of soldering is 320±10℃ and 3-5 sec.

2.1.8. EL manufactured from the organic film, and easily affected by temperature, humidity and other environmental impact. Long-term placement in a place will cause low quality of the case. Therefore, unpack the cartons and start the production with the LCM within three months after the reception of them.

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 is inductive to static, a relative humidity of 50-60% is recommended.

2.3 Operation Precautions:
2.3.1. Since applied DC voltage causes electro-chemical reactions, which deteriorate the display, 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. Driving voltage should be kept within specified range; excess voltage will shorten display life.

2.3.3. An electrochemical reaction due to direct current causes LCD deterioration, Avoid the use of -Response time will be extremely delayed at lower temperature than the operating temperature range and on the other hand at higher temperature LCD's show dark color in them.

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: $\leq$ 50%

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

Display function at room temperature: Normal

Appearance: Normal

3.General Specification

(1) Mechanical Dimension

Item	Standard Value	Unit
Number of dots	128×64	dots
Module dimension (L*W*H)	75.0 x 52.7 x 8.9(edge LED)	mm
View area	60(W)×32.6(H)	mm
Active area	55.0(W)×27.48(H)	mm
Dot size	0.39(W)×0.39(H)	mm
Dot pitch	0.43(W)×0.43(H)	mm

(2) Controller IC: NT7107/NT7108

(3) Temperature Range

	Wide
Operating	-20 ~ +70℃
Storage	-30 ~ +80℃

4.Absolute Maximum Rating

Item	Symbol	Min	Typ	Max	Unit
Operating Temperature	T_{OP}	-20	─	+70	℃
Storage Temperature	T_{ST}	-30	─	+80	℃
Input Voltage	V_I	0	─	V_{CC}	V
Supply Voltage For Logic	V_{DD}	-0.3	─	7.0	V
Supply Voltage For LCD	$V_{DD} - V_{EE}$	V_{DD} -19	─	V_{DD} -0.3	V

5.Electrical Characteristics

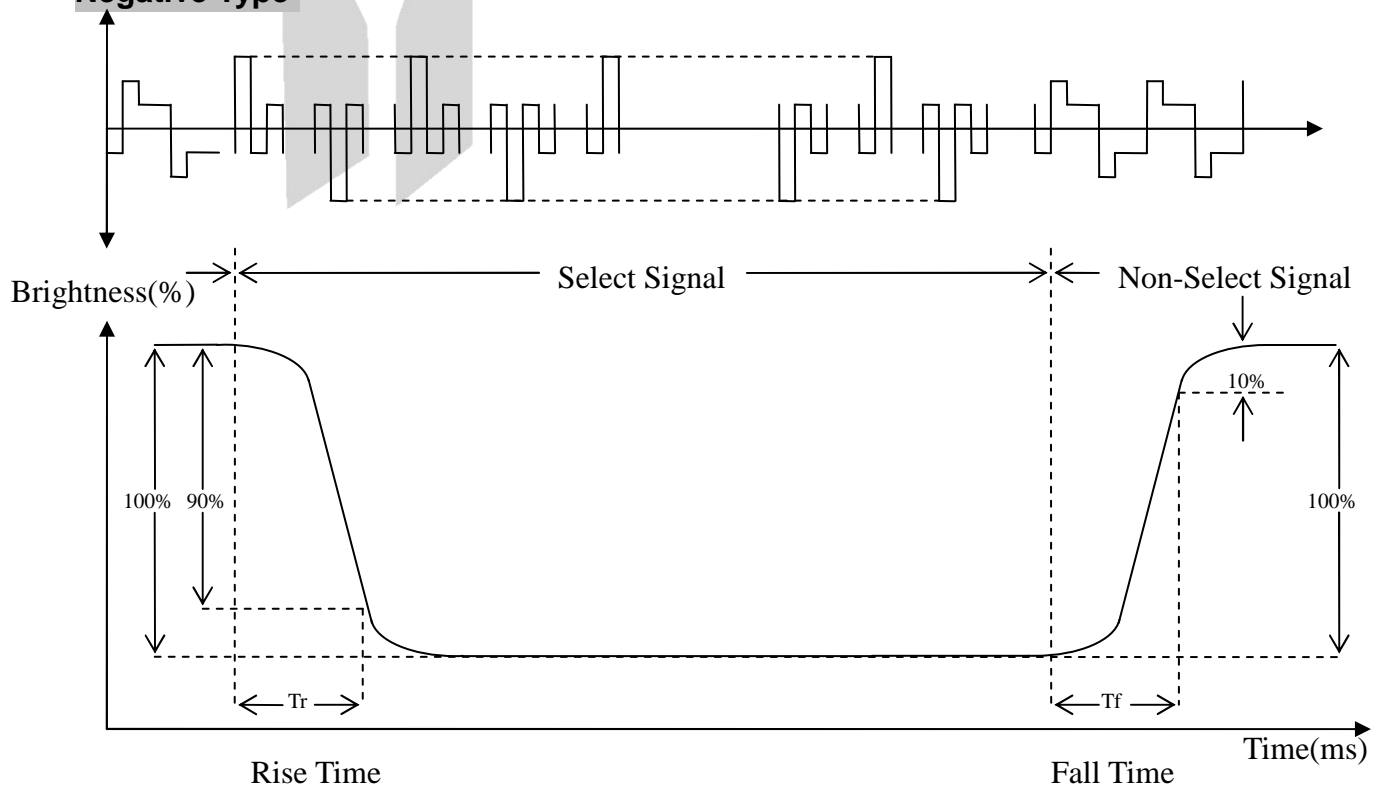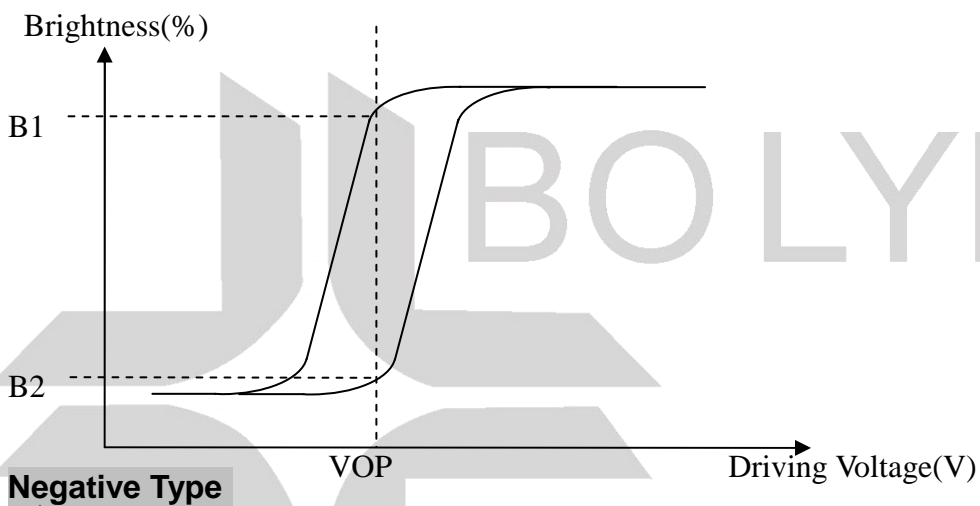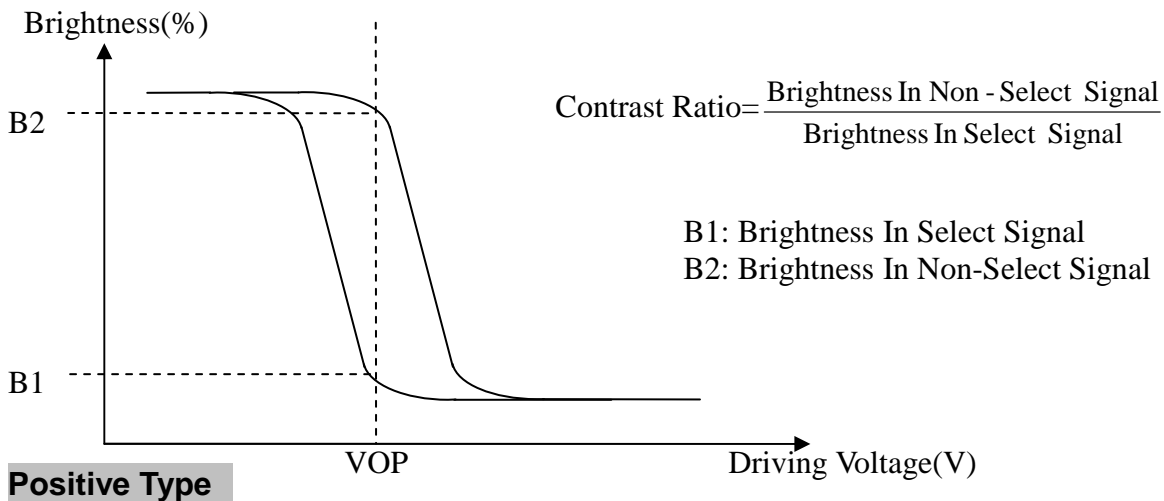| Item	Symbol	Condition	Min.	Typ.	Max.	Unit
Supply Voltage For Logic	V_{DD}-V_{SS}	—	4.75	5.0	5.25	V
Supply Voltage For LCD	V_{DD}-V_0	Ta=25℃	8.2	8.5	8.8	V
Input High Vol	V_{IH}	—	V_{DD}-2.2	—	V_{DD}	V
Input Low Vol	V_{IL}	—	0	—	0.8	V
Output High Vol	V_{OH}	—	V_{DD}-0.3	—	V_{DD}	V
Output Low Vol.	V_{OL}	—	0	—	0.3	V
Supply Current	I_{DD}	—	—	5.0	—	mA
LCM Surface Luminance Ta=25℃	L	I_{LED}=80mA Display all ON	110	165	—	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	Condition	Min.	Typ.	Max.	Unit
View Angle	(V) θ	CR $\geqq$ 3	10	-	60	deg
	(H) φ	CR $\geqq$ 3	-45	-	45	deg
Contrast Ratio	CR	-	-	5	-	-
Response Time 25℃	T rise	-	-	200	400	ms
	T fall	-	-	250	400	ms

Brightness(%)

B2

B1

VOP   Driving Voltage(V)

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

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

Positive Type

Brightness(%)

B1

B2

VOP   Driving Voltage(V)

BOLYMIN

Negative Type

Brightness(%)   Select Signal   Non-Select Signal

10%

100% 90%   100%

Tr   Tf

Rise Time   Fall Time   Time(ms)
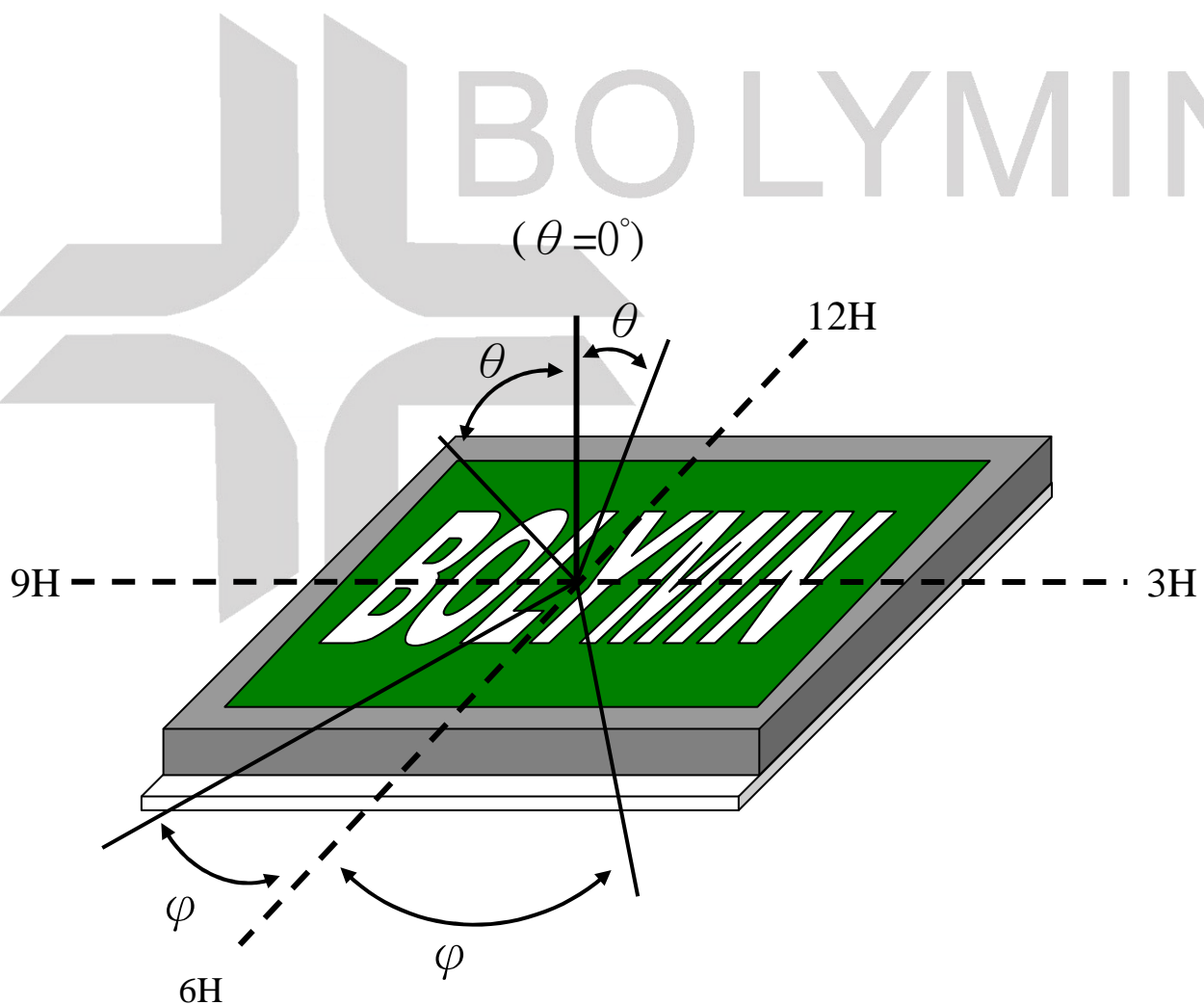
7.Interface Pin Function

Pin No.	Symbol	Level	Description
1	Vdd	5.0V	Supply voltage for logic
2	GND	0V	Ground
3	V_O	(Variable)	Operating voltage for LCD
4	DB0	H/L	Data bus line
5	DB1	H/L	Data bus line
6	DB2	H/L	Data bus line
7	DB3	H/L	Data bus line
8	DB4	H/L	Data bus line
9	DB5	H/L	Data bus line
10	DB6	H/L	Data bus line
11	DB7	H/L	Data bus line
12	/CS1	L	Chip Select for IC1
13	/CS2	L	Chip Select for IC2
14	/RST	L	Reset signal
15	R/W	H/L	H=Read mode , L=Write mode
16	D/I	H/L	H=Data register , L=Instruction register
17	E	H/L	Enable signal
18	Vee		Negative Voltage output –4.8V
19	A	—	Power supply for B/L (+)
20	K	—	Power supply for B/L (GND)

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

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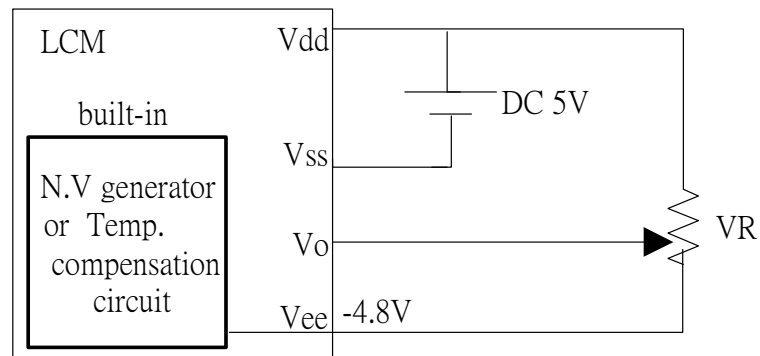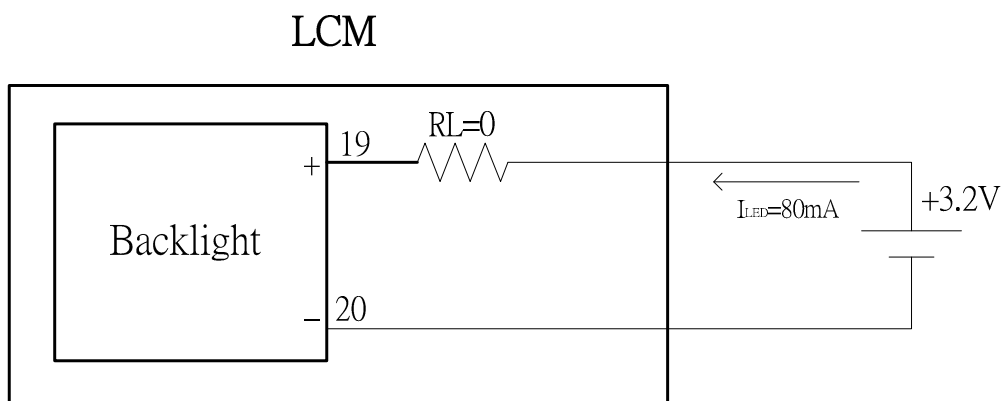

9.Backlight information

9.1 Specification

(1)LED edge/white

Parameter	Symbol	Min	Typ	Max	Unit	Test Condition
Supply Current	ILED	—	80	—	mA	V=3.2V
Supply Voltage	V	2.8	3.2	3.6	V	ILED=80mA
Reverse Voltage	VR	—	—	5	V	—
CIE Chromaticity Diagram	X	0.27	—	0.32	nm	ILED=80mA
	Y	0.27	—	0.32		
Color	White					

9.2 Backlight driving methods
   a. B/L drive from pin19 (LED+) pin20 (LED-)
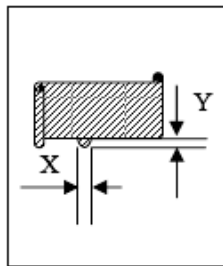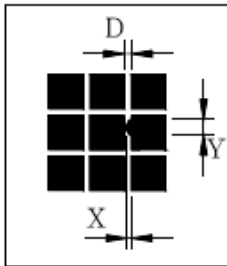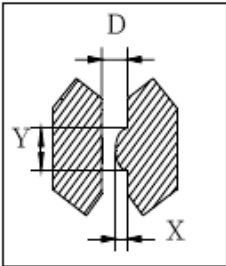   a1 LED edge/white

LCM
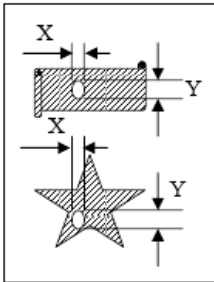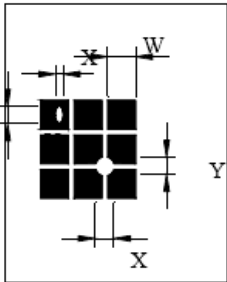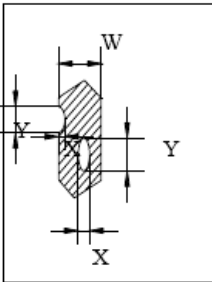
10. Quality Assurance

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.

10.2 Inspection Parameters

NO.	Parameter	Criteria			

Parameter 1: Black or White spots

Dimension \ Zone	Acceptable Number	Class Of Defects	Acceptable Level
$D \leq 0.10$	Disregard		
$0.10 < D \leq 0.2$	4	Minor	2.5
$0.2 < D \leq 0.3$	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.

Parameter 2: Scratch, Substances

Zone X(mm)	Zone Y(mm)	Acceptable Number	Class Of Defects	Acceptable Level
—	$0.05 \geq W$	Disregard		
$4.0 \geq L$	$0.05 \geq W$	4	Minor	2.5
$3.0 \geq L$	$0.1 \geq W$	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.

		Zone / Dimension	Acceptable Number	Class Of Defects	Acceptable Level
3	Air Bubbles (between glass & polarizer)	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.

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		

$$\text{Ø}=(X+Y)/2$$

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 $$\text{Ø}=(X+Y)/2$$

Other Inspection standard reference Bolymin standard.

11.Reliability
■Content of Reliability Test

No	Test Item	Content of Test	Test Condition	Applicable Standard
	Environmental Test			
1	High Temperature storage	Endurance test applying the high storage temperature for a long time.	80℃ 168 hrs	――
2	Low Temperature storage	Endurance test applying the high storage temperature for a long time.	-30℃ 168 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℃ 168 hrs	――
4	Low Temperature Operation	Endurance test applying the electric stress under low temperature for a long time.	-20℃ 168 hrs	――
5	Humidity Test	Endurance test applying the high humidity storage for a long time.	40℃,90%RH 96 hrs	――
6	Temperature cycle (Non-operation)	Endurance test applying the low and high temperature cycle. -30℃ 80℃ ◀―――――――――▶ 30min 30min 1 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.Appendix (Drawing , IC controller data)
12.1 Drawing

PIN NO.	SYMBOL
1	Vdd
2	GND
3	Vo
4	DB0
5	DB1
6	DB2
7	DB3
8	DB4
9	DB5
10	DB6
11	DB7
12	/CS1
13	/CS2
14	/RST
15	R/W
16	D/I
17	E
18	Vee
19	A
20	K
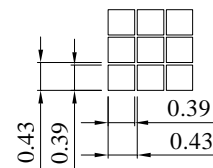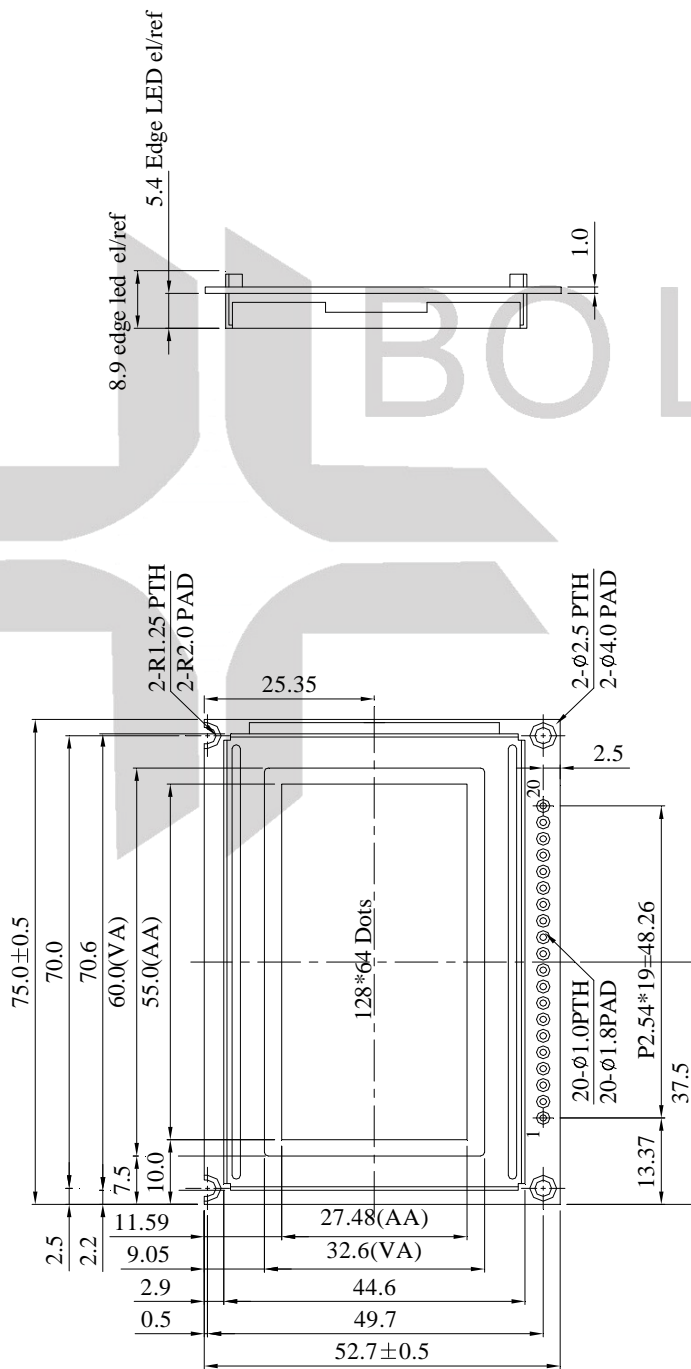
寶麗明 份有限 司
BOLYMIN,INC.

The non-specified tolerance of dimension is ±0.3 mm .

SCALE:	1/1	REV: 0
UNIT:	mm	PAGE: 1/1
APPROVE		MODEL BG12864E
CHECK		TITLE LCM DRAWING
DRAW	DEAN 08/31/12	DWG NO.

5.4 Edge LED eI/ref
8.9 edge led eI/ref
1.0

2-R1.25 PTH
2-R2.0 PAD
25.35
2-Ø2.5 PTH
2-Ø4.0 PAD
2.5
20

75.0±0.5
70.0
70.6
60.0(VA)
55.0(AA)
128*64 Dots
P2.54*19=48.26
20-Ø1.0PTH
20-Ø1.8PAD
37.5
13.37
7.5
10.0
2.5
2.2
11.59
27.48(AA)
9.05
32.6(VA)
2.9
44.6
0.5
49.7
52.7±0.5

DOT SIZE
SCALE 10/1
0.43
0.39
0.39
0.43

12.2 IC controller data

12.2.1 Display Control Instruction

The display control instructions control the internal state of theNT7108. Instruction is received from MPU to NT7108 for the display control. The following table shows various instructions.

Instruction	D/I	R/W	DB7	DB6	DB5	DB4	DB3	DB2	DB1	DB0	Function
Display ON/OFF	0	0	0	0	1	1	1	1	1	0/1	Controls the display on or off. Internal status and display RAM data are not affected. 0:OFF, 1:ON
Set Address	0	0	0	1	Y address (0~63)						Sets the Y address in the Y address counter.
Set Page (X address)	0	0	1	0	1	1	1	Page (0 ~7)			Sets the X address at the X address register.
Display Start Line	0	0	1	1	Display start line(0~63)						Indicates the display data RAM displayed at the top of the screen.

Status Read	0	1	BUSY	0	ON/OFF	RESET	0	0	0	0	Read status.
											BUSY 0:Ready
											        1:In operation
											ON/OFF 0:Display ON
											        1:Display OFF
											RESET 0:Normal
											        1:Reset

Write Display Data	1	0	Display Data								Writes data (DB0:7)into display data RAM. After writing instruction, Y address is increased by 1 automatically.
Read Display Data	1	1	Display Data								Reads data (DB0:7) from display data RAM to the data bus.

Detailed Explanation

Display On/Off

R/W	D/I	DB7	DB6	DB5	DB4	DB3	DB2	DB1	DB0
0	0	0	0	1	1	1	1	1	D

The display data appears when D is and disappears when D is 0. Though the data is not on the screen with D = 0, it remains in the display data RAM. Therefore, you can make it appear by changing D = 0 into D = 1.

Display Start Line

R/W	D/I	DB7	DB6	DB5	DB4	DB3	DB2	DB1	DB0
0	0	1	1	A	A	A	A	A	A

Z address AAAAAA (binary) of the display data RAM is set in the display start line register and displayed at the top of the screen. Figure 2. shows examples of display (1/64 duty cycle) when the start line = 0-3. When the display duty cycle is 1/64 or more (ex. 1/32, 1/24 etc.), the data of total line number of LCD screen,   from the line specified by display start line instruction, is displayed.

Set Page (X Address)

R/W	D/I	DB7	DB6	DB5	DB4	DB3	DB2	DB1	DB0
0	0	1	0	1	1	1	A	A	A

X address AAA (binary) of the display data RAM is set in the X address register.After that, writing

or reading to or from MPU is executed in this specified page until the next page is set. See Figure 1.

Set Y Address

R/W	D/I	DB7	DB6	DB5	DB4	DB3	DB2	DB1	DB0
0	0	0	1	A	A	A	A	A	A

Y address AAAAAA (binary) of the display data RAM is set in the Y address counter. After that, Y address counter is increased by 1 every time the data is written or read to or from MPU.

Status Read

R/W	D/I	DB7	DB6	DB5	DB4	DB3	DB2	DB1	DB0
0	0	Busy	0	On/Off	RESET	0	0	0	0

•Busy

When busy is 1, the LSI is executing internal operations. No instruction are accepted while busy is 1, so you should make sure that busy is 0 before writing the next instruction.

•ON/OFF

Shows the liquid crystal display condition: on condition or off condition.

When on/off is 1, the display is in off condition.

When on/off is 0, the display is in on condition.

•RESET

RESET = 1 shows that the system system is being initialized. In this condition, no instructions except status read can be accepted.

RESET = 0 shows that initializing has system is in the usual operation condition.

Write Display Data

R/W	D/I	DB7	DB6	DB5	DB4	DB3	DB2	DB1	DB0
0	0	D	D	D	D	D	D	D	D

Writes 8-bit data DDDDDDDD (binary) into the display data RAM. The Y address is increased by 1 automatically.

Read Display Data

R/W	D/I	DB7	DB6	DB5	DB4	DB3	DB2	DB1	DB0
0	0	D	D	D	D	1	D	D	D

Reads out 8-bit data DDDDDDDD (binary) from the display data RAM. Then Y address is increased by 1 automatically.

One dummy read is necessary right after the address setting. For details, refer to the explanation of output register in "Function of Each Block".
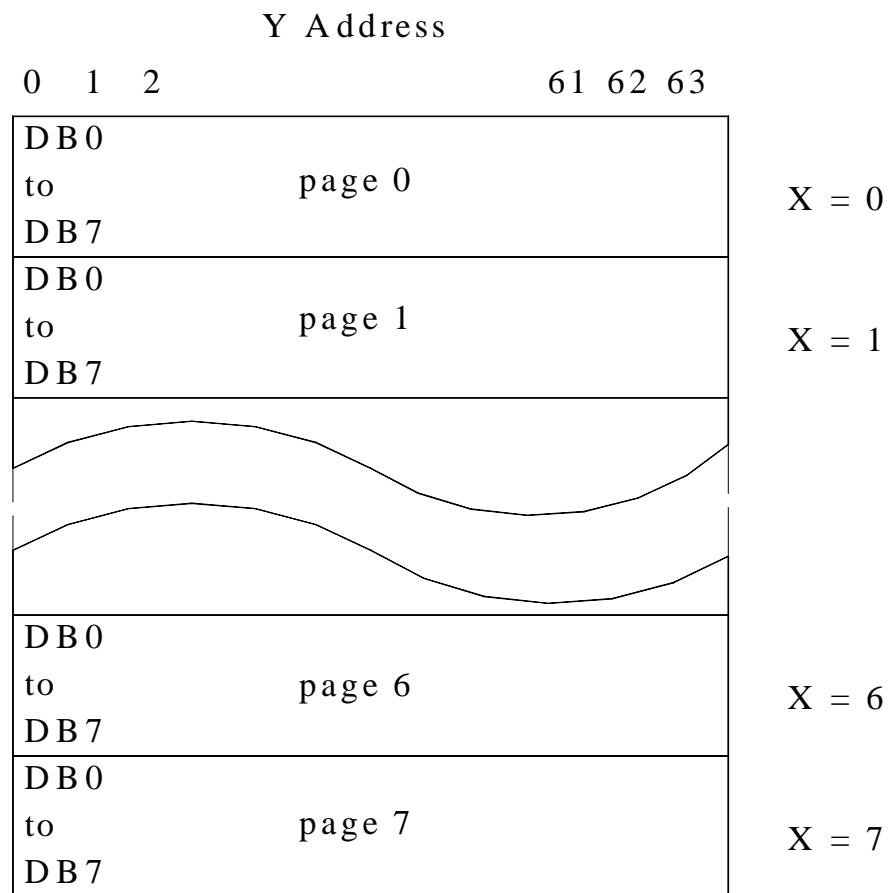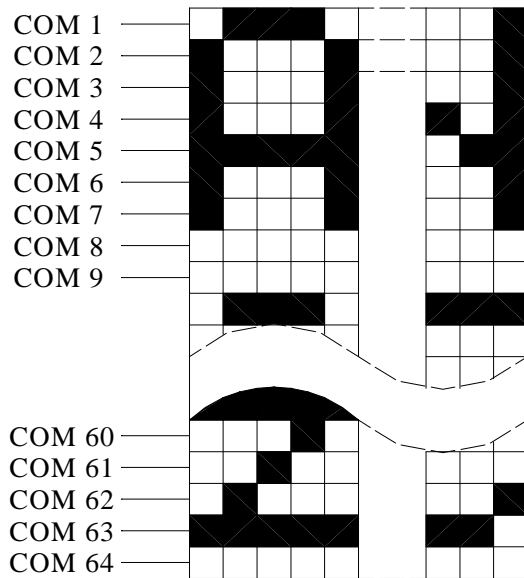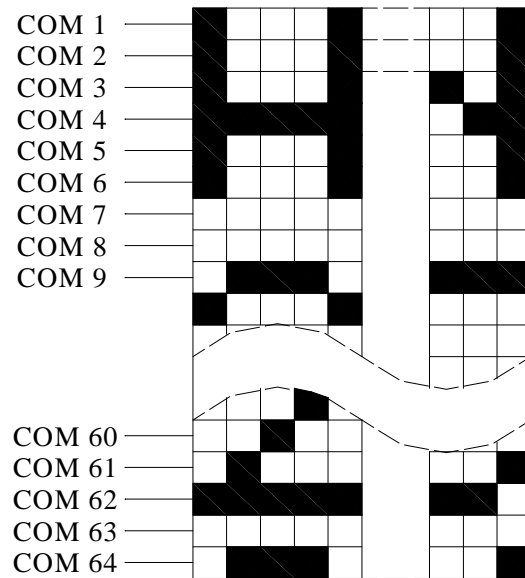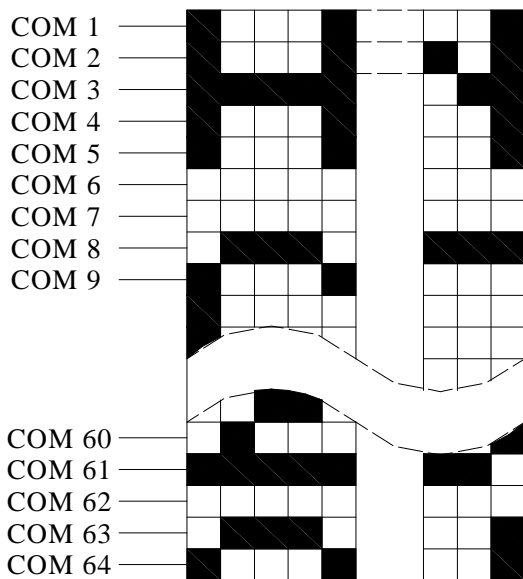
Y Address

		0 1 2	61 62 63	

```
                    Y  Address

  0   1   2                         61  62  63
┌─────────────────────────────────────────────┐
│ DB0                                           │
│ to              page 0                         │   X = 0
│ DB7                                           │
├─────────────────────────────────────────────┤
│ DB0                                           │
│ to              page 1                         │   X = 1
│ DB7                                           │
├─────────────────────────────────────────────┤
│                                               │
│                                               │
│                                               │
├─────────────────────────────────────────────┤
│ DB0                                           │
│ to              page 6                         │   X = 6
│ DB7                                           │
├─────────────────────────────────────────────┤
│ DB0                                           │
│ to              page 7                         │   X = 7
│ DB7                                           │
└─────────────────────────────────────────────┘
```

Figure 1

COM 1
COM 2
COM 3
COM 4
COM 5
COM 6
COM 7
COM 8
COM 9

COM 60
COM 61
COM 62
COM 63
COM 64

Start line = 0

COM 1
COM 2
COM 3
COM 4
COM 5
COM 6
COM 7
COM 8
COM 9

COM 60
COM 61
COM 62
COM 63
COM 64

Start line = 1

COM 1
COM 2
COM 3
COM 4
COM 5
COM 6
COM 7
COM 8
COM 9

COM 60
COM 61
COM 62
COM 63
COM 64

Start line = 3

COM 1
COM 2
COM 3
COM 4
COM 5
COM 6
COM 7
COM 8
COM 9

COM 60
COM 61
COM 62
COM 63
COM 64

Start line = 4

Figure 2

12.2.2 Timing characteristics

Characteristic	Symbol	Min	Type	Max	Unit
E cycle	t_C	1000	-	-	
E high level width	t_{WH}	450	-	-	
E low level width	t_{WL}	450	-	-	
E rise time	t_R	-	-	25	
E fall time	t_F	-	-	25	
Address set-up time	t_{ASU}	140	-	-	ns
Address hold time	t_{AH}	10	-	-	
Data set-up time	t_{DSU}	200	-	-	
Data delay time	t_D	-	-	320	
Data hold time (write)	t_{DHW}	10	-	-	
Data hold time (read)	t_{DHR}	20	-	-	
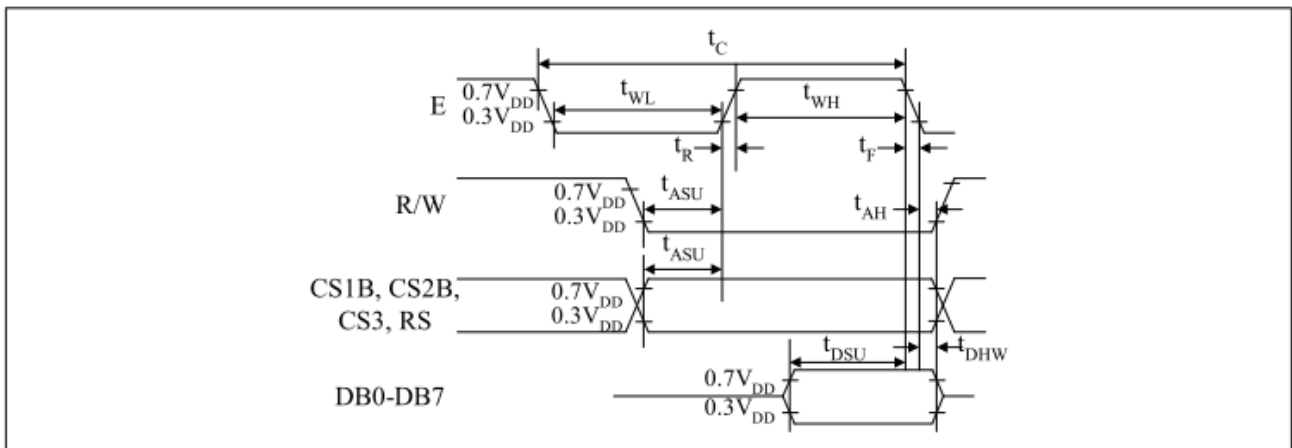
MPU Write Timing

MPU Read Timing