

BOLYMIN

**SPECIFICATIONS FOR
LCD MODULE**

MODEL NO.
BC2002BBNHEH\$
VER.01

ROHS
COMPLIANT

FOR MESSRS:

ON DATE OF:

APPROVED BY:

BOLYMIN, INC.

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History of Version

Version	Contents	Date	Note
01	NEW VERSION	2013/06/28	SPEC.

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1. Numbering System

<u>B</u>	<u>C</u>	<u>2002</u>	<u>B</u>	<u>B</u>	<u>N</u>	<u>H</u>	<u>E</u>	<u>H</u>	<u>\$</u>
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 volt logic power supply n=negative voltage for LCD c=cable/connector xxx=to be assigned on datasheet				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 $20^{\circ}\text{C} \pm 5^{\circ}\text{C}$ 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 $320 \pm 10^{\circ}\text{C}$ 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 °C normal operation temperature is 50,000hours. Estimator of L(10) is 5,268 hours. Remark: L(10) means accumulative defect rate equals 10% at the time of L(10).

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:

Loss of brightness at specific measured point: $\leq 50\%$

Loss of brightness at specific measured point: $\leq 20\%$

Display function at room temperature: Normal

Appearance: Normal

3. General Specification

(1) Mechanical Dimension

Item	Dimension	Unit
Number of Characters	20characters x2 Lines	—
Module dimension (L x W x H)	180.0 x 40.0 x 13.4 (Max) – LED B/L,	mm
View area	149.0x23.0	mm
Active area	142.8 x 20.64	mm
Dot size	1.12 x 1.12	mm
Dot pitch	1.22 x 1.22	mm
Character size (L x W)	6.00 x 9.66	mm
Character pitch (L x W)	7.20 x 10.98	mm

(2) Controller IC: **ST7066U (or Equivalent) controller**

(3) Temperature Range

	Wide
Operating	-20~+70°C
Storage	-30~+80°C

4. Absolute Maximum Rating

4.1 Electrical Absolute Maximum Ratings

(Vss=0V, Ta=25°C)

Item	Symbol	Min	Max	Unit
Supply Voltage (Logic)	Vdd-Vss	-0.3	7	V
Supply Voltage (LCD driver)	Vdd-Vo	-0.3	10	V
Input Voltage	Vi	Vss	Vdd	V
Wide Temperature Type	Top	-20	+70	°C
	Tstg	-30	+80	°C

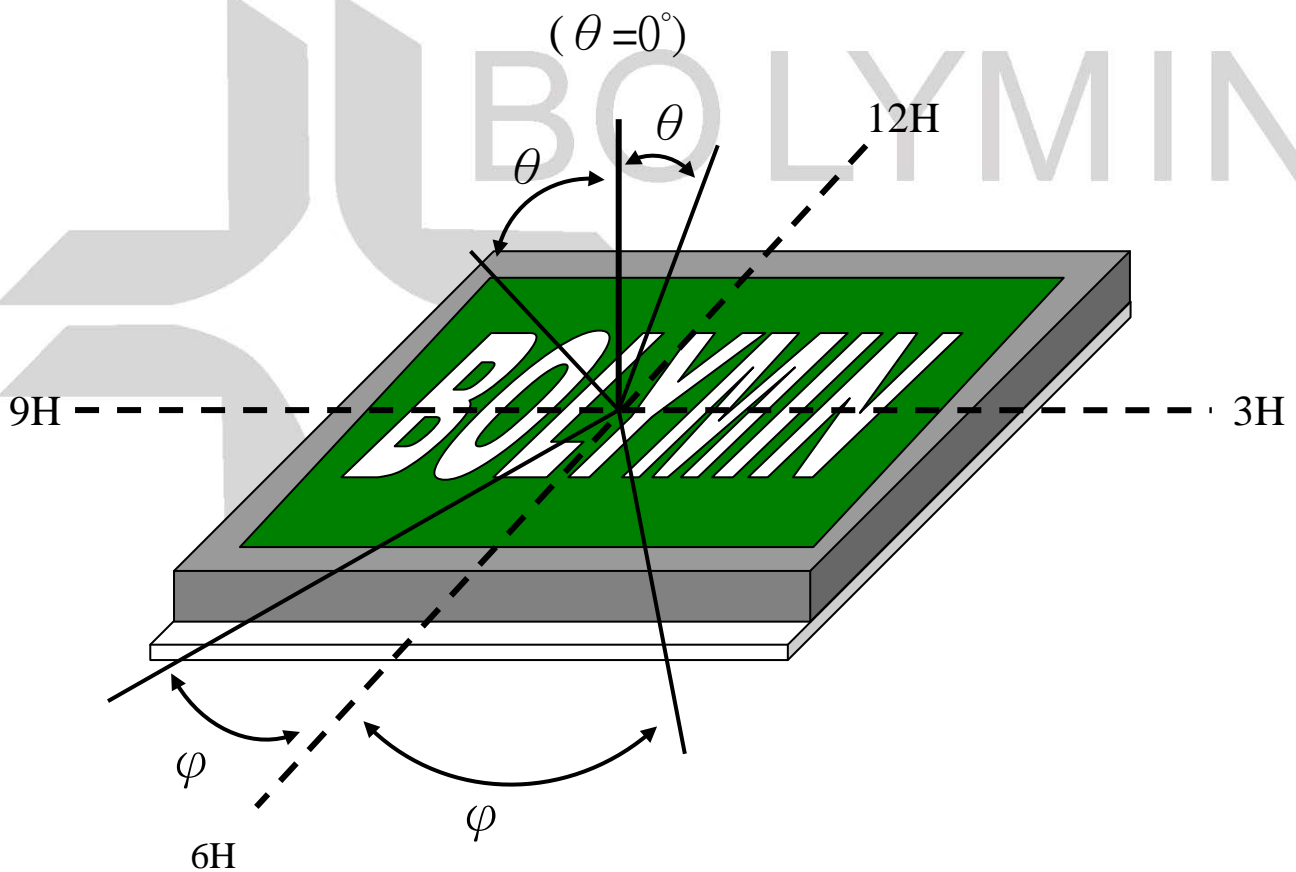
5. Electrical Characteristics

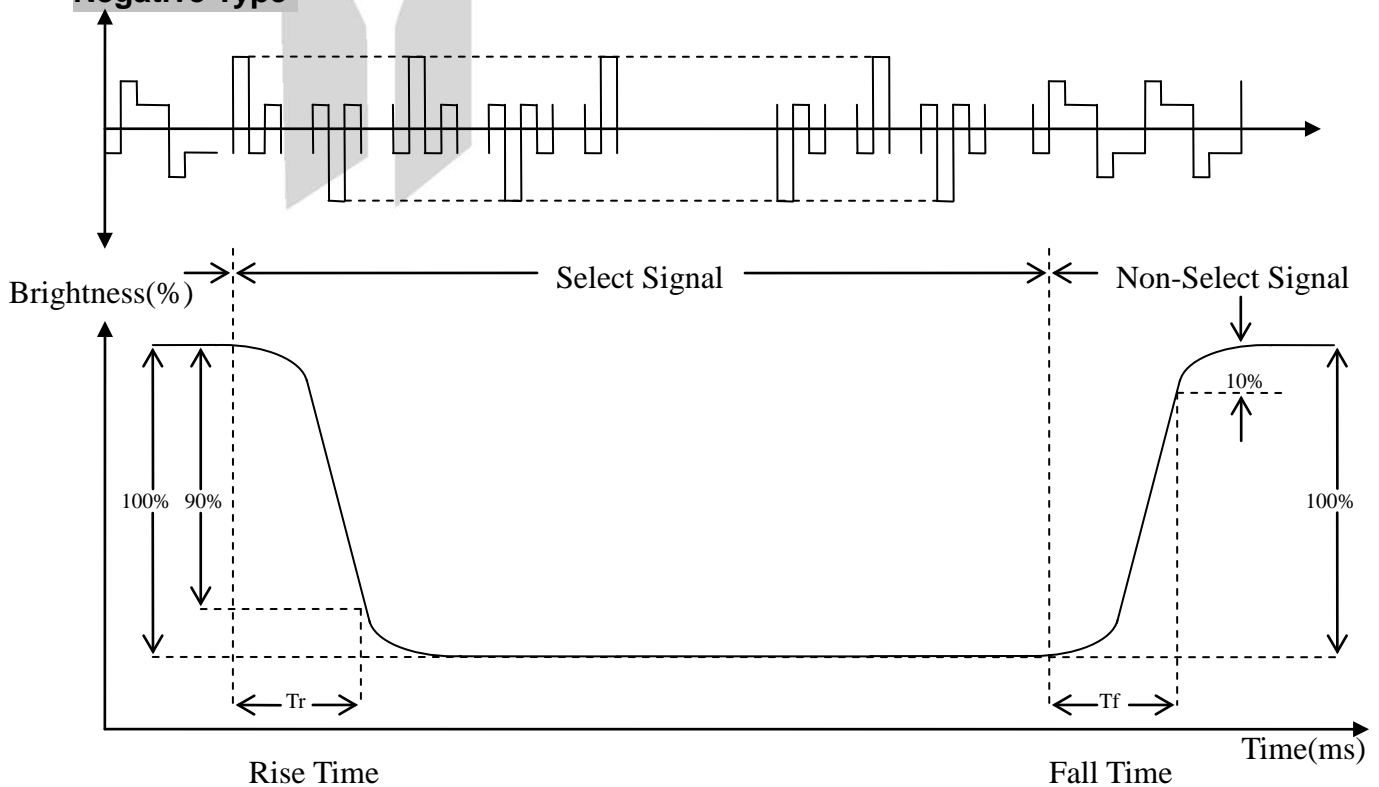
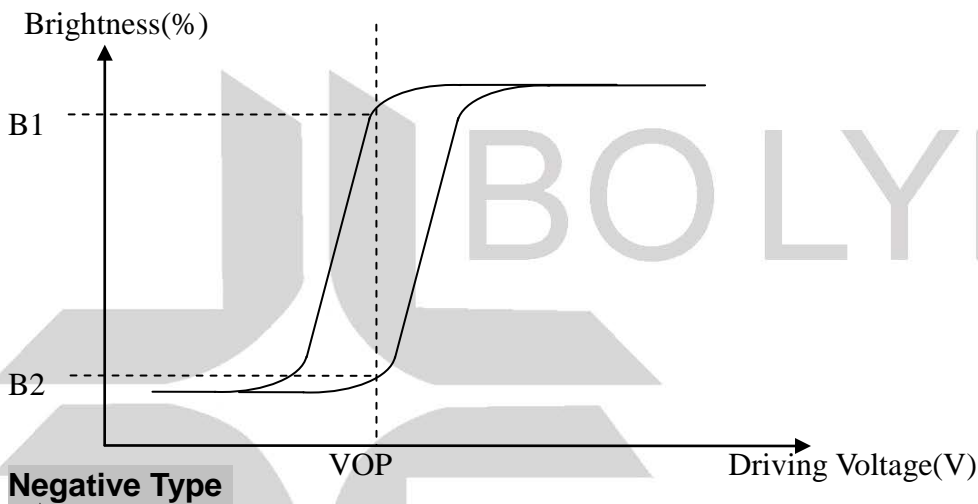
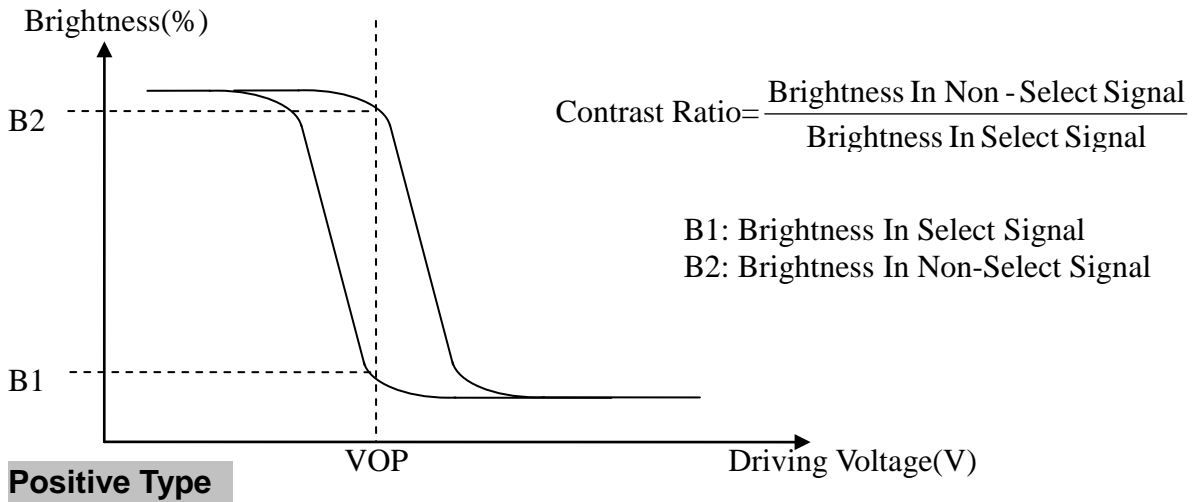
Item	Symbol	Condition	Min	Typ	Max	Unit
Supply Voltage For Logic	Vdd-Vss	-	4.75	-	5.25	V
Supply Voltage For LCD *Wide Temp · Type	Vdd-Vo	*Ta=-20°C	-	4.6	-	V
		Ta=0°C	-	-	-	V
		Ta=25°C	-	4.5	-	V
		Ta=50°C	-	-	-	V
		*Ta=+70°C	-	4.4	-	V
Input High Volt.	V _{IH}	-	0.7V _{DD}	-	Vdd	V
Input Low Volt.	V _{IL}	-	—	-	0.6	V
Output High Volt.	V _{OH}	-	0.8V _{DD}	-	-	V
Output Low Volt.	V _{OL}	-	-	-	0.4	V
Supply Current	I _{dd}	Vdd=5V	-	1.2	-	mA
LCM Surface Luminance Ta=25°C	L	I _{LED} =45mA Display allOFF	35	52	—	cd/m ²

6. Optical Characteristics

a. . STN

Item	Symbol	Condition	Min.	Typ.	Max.	Unit
View Angle	(V) θ	$CR \geq 2$	10	-	45	deg
	(H) φ	$CR \geq 2$	-30	-	30	deg
Contrast Ratio	CR	-	-	3	-	-
Response Time 25°C	T rise	-	-	200	350	ms
	T fall	-	-	250	400	ms



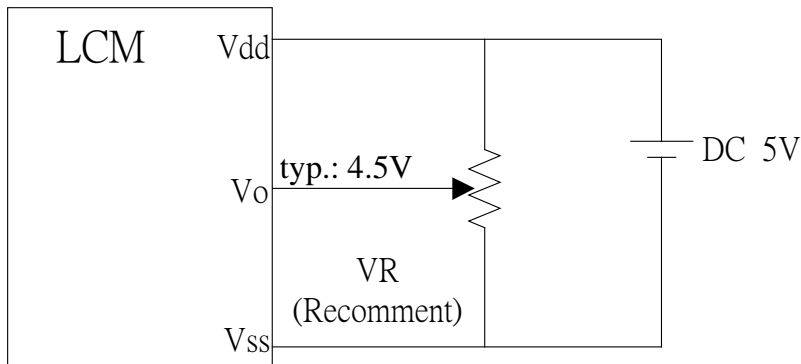


7.Interface Pin Function

Pin No.	Symbol	Level	Description
1	Vss	0V	Ground
2	Vdd	5.0V	Supply Voltage for logic
3	Vo	(Variable)	Operating voltage for LCD
4	RS	H/L	H:DATA, L:Instruction code
5	R/W	H/L	H:Read(MPU→Module)L:Write(MPU→Module)
6	E	H,H→L	Chip enable signal
7	DB0	H/L	Data bit 0
8	DB1	H/L	Data bit 1
9	DB2	H/L	Data bit 2
10	DB3	H/L	Data bit 3
11	DB4	H/L	Data bit 4
12	DB5	H/L	Data bit 5
13	DB6	H/L	Data bit 6
14	DB7	H/L	Data bit 7
15	A	-	Power supply for LED backlight (+)
16	K	-	Power supply for LED backlight (GND)

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

Standard Type



9. Backlight information

9.1 Specification

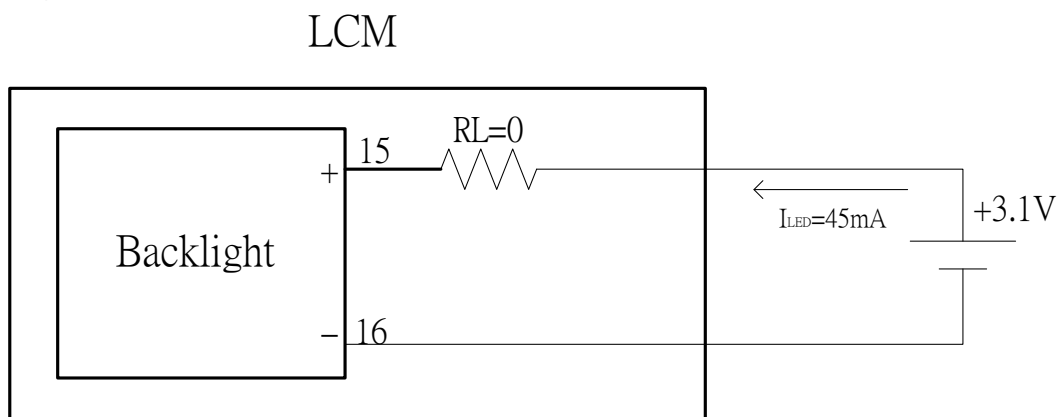
(1) LED edge / white

Parameter	Symbol	Min	Typ	Max	Unit	Test Condition
Supply Current	I _{LED}	—	45	—	mA	V= 3.1V
Supply Voltage	V	2.9	3.1	3.3	V	I _{LED} =45 mA
Reverse Voltage	V _R	—	—	5	V	
CIE	X	0.27	—	0.32		I _{LED} =45 mA
	Y	0.27	—	0.32		
Color	white					

9.2 Backlight driving methods

a. LED B/L drive from pin15 (LED+) pin16 (LED-)

a.1 edge / white



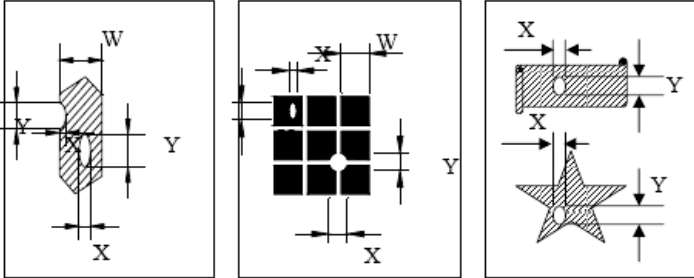
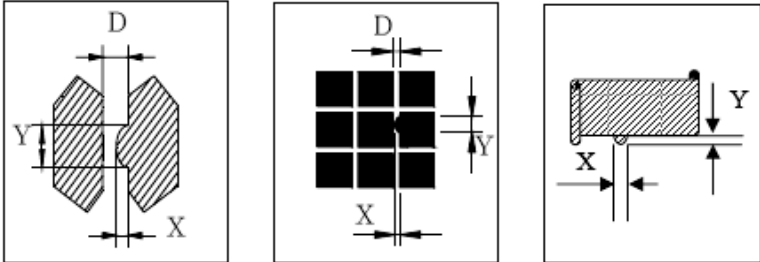
10. Quality Assurance

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

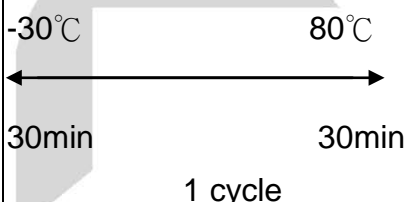
NO.	Parameter	Criteria				
1	Black or White spots	Zone		Acceptable Number	Class Of Defects	Acceptable Level
		Dimension				
		$D \leq 0.10$		Disregard	Minor	2.5
		$0.10 < D \leq 0.2$		4		
		$0.2 < D \leq 0.3$		2		
$0.3 < D$		0				
<p>$D = (\text{Long} + \text{Short}) / 2$ Total defects should not exceed 5/module Defect that is located at outside of AA and doesn't affect function is ignored.</p>						
2	Scratch, Substances	Zone		Acceptable Number	Class Of Defects	Acceptable Level
		X(mm)	Y(mm)			
		—	$0.05 \geq W$	Disregard	Minor	2.5
		$4.0 \geq L$	$0.05 \geq W$	4		
		$3.0 \geq L$	$0.1 \geq W$	2		
—	$0.1 < W$	0				
<p>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.</p>						

3	Air Bubbles (between glass & polarizer)	<table border="1"> <tr> <th>Zone Dimension</th> <th>Acceptable Number</th> <th>Class Of Defects</th> <th>Acceptable Level</th> </tr> <tr> <td>$D \leq 0.2$</td> <td>Disregard</td> <td rowspan="3">Minor</td> <td rowspan="3">2.5</td> </tr> <tr> <td>$0.2 < D \leq 0.5$</td> <td>3</td> </tr> <tr> <td>$0.5 < D$</td> <td>0</td> </tr> </table>	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																											
<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>																												
4	Displaying Pattern	<p>1. Incomplete or broken line is not allowed. 2. Pinholes</p> <table border="1"> <tr> <th>Dimension Φ(mm)</th> <th>Criteria</th> <th>Class Of Defects</th> <th>Acceptable Level</th> </tr> <tr> <td>$\Phi < 0.1$</td> <td>Disregard</td> <td rowspan="4">Minor</td> <td rowspan="4">2.5</td> </tr> <tr> <td>$0.1 < \Phi \leq 0.2$</td> <td>2</td> </tr> <tr> <td>$0.2 < \Phi \leq 0.25$</td> <td>1</td> </tr> <tr> <td>$0.25 < \Phi$</td> <td>0</td> </tr> </table>  <p style="text-align: center;">$\phi = (X+Y)/2$</p> <p>3. Deformation</p> <table border="1"> <tr> <th>Dimension Φ(mm)</th> <th>Criteria</th> <th>Class Of Defects</th> <th>Acceptable Level</th> </tr> <tr> <td>$\Phi < 0.15$</td> <td>Disregard</td> <td rowspan="3">Minor</td> <td rowspan="3">2.5</td> </tr> <tr> <td>$\Phi \leq 0.25$ and $X \leq 1/2D$</td> <td>3</td> </tr> <tr> <td>$\Phi > 0.25$ and $X > 1/2D$</td> <td>0</td> </tr> </table>  <p style="text-align: center;">D : 間距 $\phi = (X+Y)/2$</p>	Dimension Φ (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 Φ (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 Φ (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 Φ (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

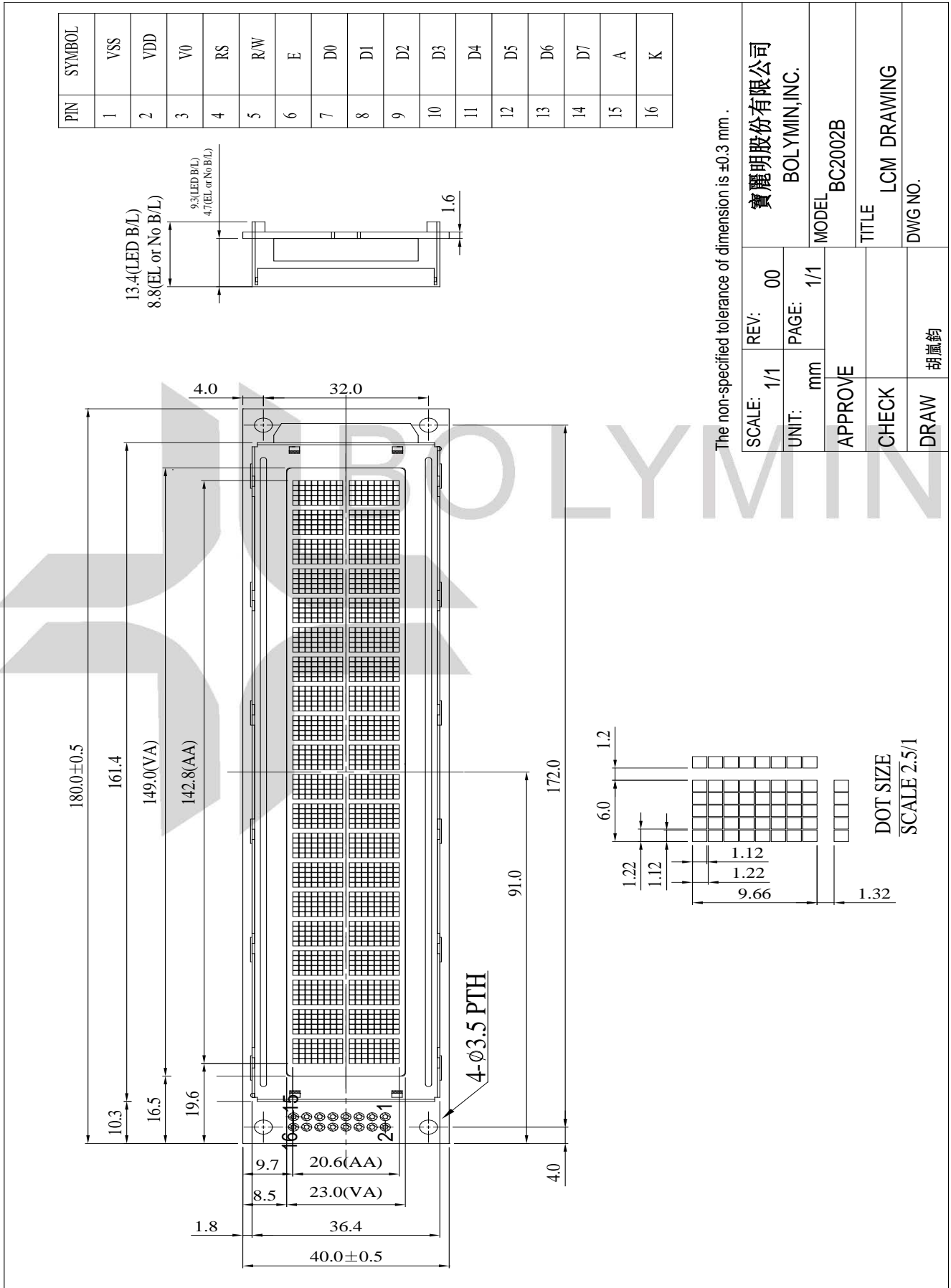
■ Content of Reliability Test

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°C 168 hrs	—
2	Low Temperature storage	Endurance test applying the high storage temperature for a long time.	-30°C 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°C 168 hrs	—
4	Low Temperature Operation	Endurance test applying the electric stress under low temperature for a long time.	-20°C 168 hrs	—
5	Humidity Test	Endurance test applying the high humidity storage for a long time.	40°C, 90%RH 96hrs	—
6	Temperature cycle (Non-operation)	Endurance test applying the low and high temperature cycle. 	-30°C / 80°C 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, ST7066U controller data)

12-1 Drawing



12-2 ST066U controller data

12.2.1 Function description

The LCD display Module is built in a LSI controller, the controller has two 8-bit registers, an instruction register (IR) and a data register (DR).

The IR stores instruction codes, such as display clear and cursor shift, and address information for display data RAM (DDRAM) and character generator (CGRAM). The IR can only be written from the MPU. The DR temporarily stores data to be written or read from DDRAM or CGRAM. When address information is written into the IR, then data is stored into the DR from DDRAM or CGRAM. By the register selector (RS) signal, these two registers can be selected.

RS	R/W	Operation
0	0	IR write as an internal operation (display clear, etc.)
0	1	Read busy flag (DB7) and address counter (DB0 to DB7)
1	0	Write data to DDRAM or CGRAM (DR to DDRAM or CGRAM)
1	1	Read data from DDRAM or CGRAM (DDRAM or CGRAM to DR)

Busy Flag (BF)

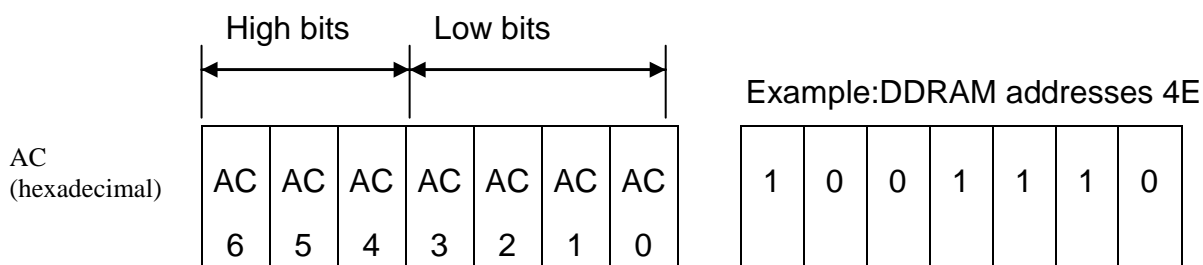
When the busy flag is 1, the controller LSI is in the internal operation mode, and the next instruction will not be accepted. When RS=0 and R/W=1, the busy flag is output to DB7. The next instruction must be written after ensuring that the busy flag is 0.

Address Counter (AC)

The address counter (AC) assigns addresses to both DDRAM and CGRAM

Display Data RAM (DDRAM)

This DDRAM is used to store the display data represented in 8-bit character codes. Its extended capacity is 80×8 bits or 80 characters. Below figure is the relationship between DDRAM addresses and positions on the liquid crystal display.



DDRAM Address

Display position DDRAM address

1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20

00	01	02	03	04	05	06	07	08	09	0A	0B	0C	0D	0E	0F	10	11	12	13
40	41	42	43	44	45	46	47	48	49	4A	4B	4C	4D	4E	4F	50	51	52	53

Example: 2-Line by 20-Character Display

Character Generator ROM (CGROM)

The CGROM generate 5×8 dot or 5×10 dot character patterns from 8-bit character codes. See Table 2.

Character Generator RAM (CGRAM)

In CGRAM, the user can rewrite character by program. For 5×8 dots, eight character patterns can be written, and for 5×10 dots, four character patterns can be written.

Write into DDRAM the character code at the addresses shown as the left column of table 1. To show the character patterns stored in CGRAM.

Relationship between CGRAM Addresses, Character Codes (DDRAM) and Character Patterns (CGRAM Data)

For 5 * 8 dot character patterns

Character Codes (DDRAM data)		CGRAM Address		Character Patterns (CGRAM data)			
7 6 5 4 3 2 1 0		5 4 3 2 1 0		7 6 5 4 3 2 1 0			
High Low		High Low		High Low			
0 0 0 0 * 0 0 0		0 0 0	0 0 0	* * *	0 0 0 0	Character pattern(1)	
			0 0 1	* * *	0 0 0 0		
			0 1 0	* * *	0 0 0 0		
			0 1 1	* * *	0 0 0 0		
			1 0 0	* * *	0 0 0 0		
			1 0 1	* * *	0 0 0 0		
			1 1 0	* * *	0 0 0 0		
			1 1 1	* * *	0 0 0 0 0		Cursor pattern
			0 0 0	* * *	0 0 0 0		
			0 0 1	* * *	0 0 0 0		
0 0 0 0 * 0 0 1		0 0 1	0 1 0	* * *	0 0 0 0	Character pattern(2)	
			0 1 1	* * *	0 0 0 0		
			1 0 0	* * *	0 0 0 0		
			1 0 1	* * *	0 0 0 0		
			1 1 0	* * *	0 0 0 0		
			1 1 1	* * *	0 0 0 0 0		Cursor pattern
0 0 0	* * *	0 0 0 0					
0 0 1	* * *	0 0 0 0					
			0 0 0	* * *			
			0 0 1	* * *			

0 0 0 0 * 1 1 1		1 1 1	1 0 0		
			1 0 1		
			1 1 0		
			1 1 1	* * *	

For 5 * 10 dot character patterns

Character Codes (DDRAM data)		CGRAM Address		Character Patterns (CGRAM data)		
7 6 5 4 3 2 1 0		5 4 3 2 1 0		7 6 5 4 3 2 1 0		
High Low		High Low		High Low		
0 0 0 0 * 0 0 0		0 0	0 0 0 0	* * *	0 0 0 0 0	Character pattern
			0 0 0 1	* * *	0 0 0 0 0	
			0 0 1 0	* * *	0 0 0 0	
			0 0 1 1	* * *	0 0 0	
			0 1 0 0	* * *	0 0 0	
			0 1 0 1	* * *	0 0 0	
			0 1 1 0	* * *	0 0 0 0	
			0 1 1 1	* * *	0 0 0 0	
			1 0 0 0	* * *	0 0 0 0	
			1 0 0 1	* * *	0 0 0 0	
1 0 1 0	* * *	0 0 0 0 0	Cursor pattern			
			1 1 1 1	* * *	* * * * *	

■ : " High "

12.2.2 C.G ROM table. table 2
Code E: English - European Font

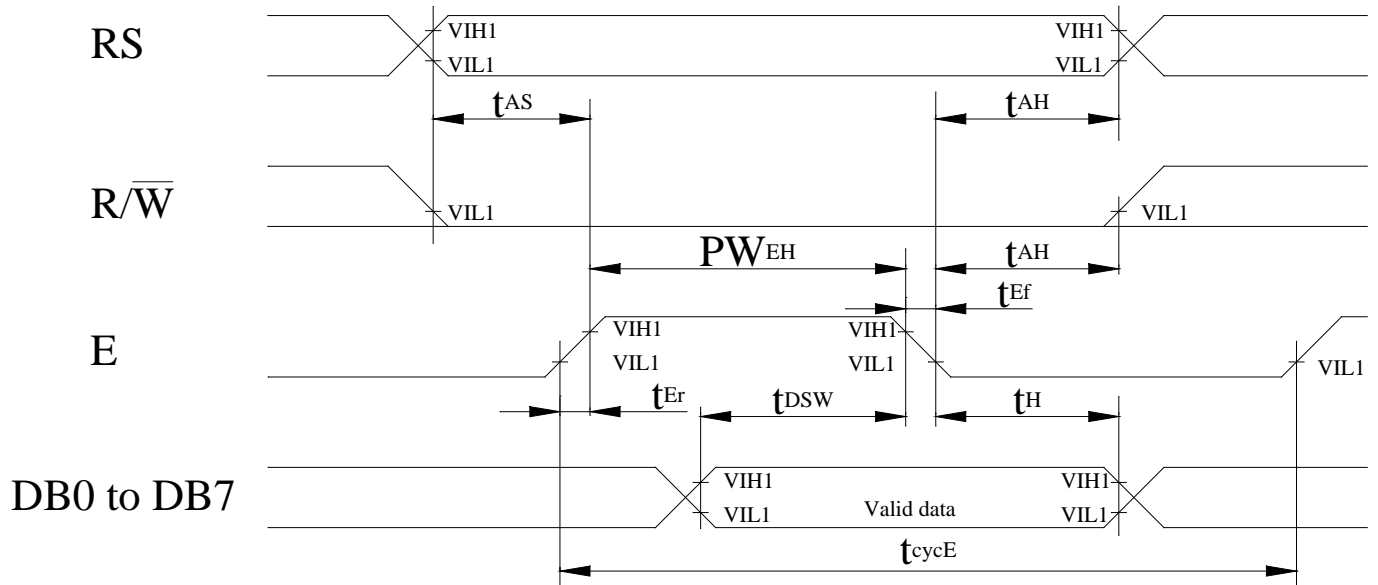
Upper 4 bit Lower 4 bit	LLLL	LLLH	LLHL	LLHH	LHLL	LHLH	LHHL	LHHH	HLLL	HLLH	HLHL	HLHH	HHLL	HHLH	HHHL	HHHH
LLLL	CG RAM (1)	!	2	3	4	5	6	7	8	9	0	1	2	3	4	5
LLLH	CG RAM (2)	6	7	8	9	0	1	2	3	4	5	6	7	8	9	0
LLHL	CG RAM (3)	1	2	3	4	5	6	7	8	9	0	1	2	3	4	5
LLHH	CG RAM (4)	6	7	8	9	0	1	2	3	4	5	6	7	8	9	0
LHLL	CG RAM (5)	1	2	3	4	5	6	7	8	9	0	1	2	3	4	5
LHLH	CG RAM (6)	6	7	8	9	0	1	2	3	4	5	6	7	8	9	0
LHHL	CG RAM (7)	1	2	3	4	5	6	7	8	9	0	1	2	3	4	5
LHHH	CG RAM (8)	6	7	8	9	0	1	2	3	4	5	6	7	8	9	0
HLLL	CG RAM (1)	1	2	3	4	5	6	7	8	9	0	1	2	3	4	5
HLLH	CG RAM (2)	6	7	8	9	0	1	2	3	4	5	6	7	8	9	0
HLHL	CG RAM (3)	1	2	3	4	5	6	7	8	9	0	1	2	3	4	5
HLHH	CG RAM (4)	6	7	8	9	0	1	2	3	4	5	6	7	8	9	0
HHLL	CG RAM (5)	1	2	3	4	5	6	7	8	9	0	1	2	3	4	5
HHLH	CG RAM (6)	6	7	8	9	0	1	2	3	4	5	6	7	8	9	0
HHHL	CG RAM (7)	1	2	3	4	5	6	7	8	9	0	1	2	3	4	5
HHHH	CG RAM (8)	6	7	8	9	0	1	2	3	4	5	6	7	8	9	0

12.2.3 Instruction table

Instruction	Instruction Code										Description	Execution time (fosc=270Khz)	
	RS	R/W	DB 7	DB 6	DB 5	DB 4	DB 3	DB 2	DB 1	DB0			
Clear Display	0	0	0	0	0	0	0	0	0	0	1	Write "00H" to DDRAM and set DDRAM address to "00H" from AC	1.52ms
Return Home	0	0	0	0	0	0	0	0	0	1	—	Set DDRAM address to "00H" from AC and return cursor to its original position if shifted. The contents of DDRAM are not changed.	1.52ms
Entry Mode Set	0	0	0	0	0	0	0	0	1	I/D	SH	Assign cursor moving direction and enable the shift of entire display.	37μs
Display ON/OFF Control	0	0	0	0	0	0	0	1	D	C	B	Set display (D), cursor (C), and blinking of cursor (B) on/off control bit.	37μs
Cursor or Display Shift	0	0	0	0	0	0	1	S/C	R/L	—	—	Set cursor moving and display shift control bit, and the direction, without changing of DDRAM data.	37μs
Function Set	0	0	0	0	0	1	DL	N	F	—	—	Set interface data length (DL:8-bit/4-bit), numbers of display line (N:2-line/1-line)and, display font type (F:5×11 dots/5×8 dots)	37μs
Set CGRAM Address	0	0	0	1	AC 5	AC 4	AC 3	AC 2	AC 1	AC0	—	Set CGRAM address in address counter.	37μs
Set DDRAM Address	0	0	1	AC 6	AC 5	AC 4	AC 3	AC 2	AC 1	AC0	—	Set DDRAM address in address counter.	37μs
Read Busy Flag and Address	0	1	BF	AC 6	AC 5	AC 4	AC 3	AC 2	AC 1	AC0	—	Whether during internal operation or not can be known by reading BF. The contents of address counter can also be read.	0μs
Write Data to RAM	1	0	D7	D6	D5	D4	D3	D2	D1	D0	—	Write data into internal RAM (DDRAM/CGRAM).	37μs
Read Data from RAM	1	1	D7	D6	D5	D4	D3	D2	D1	D0	—	Read data from internal RAM (DDRAM/CGRAM).	37μs

12.2.4 Timing characteristics

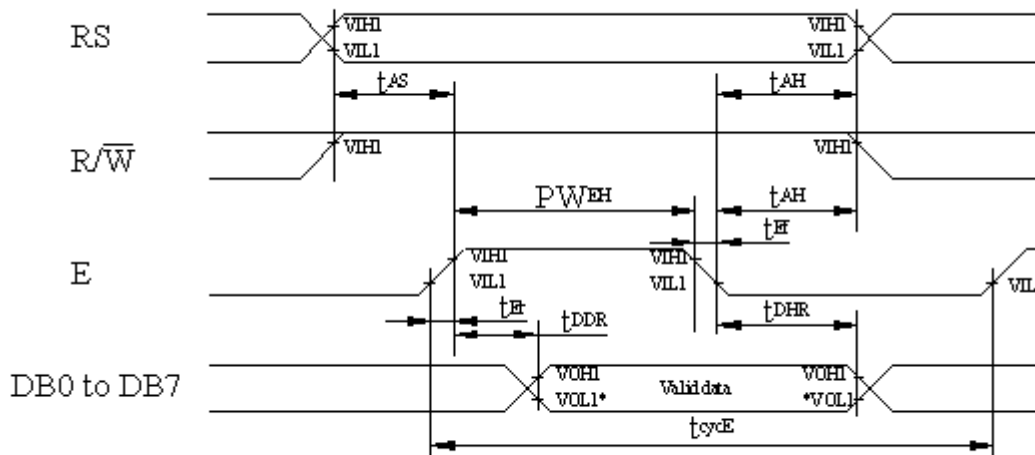
12.2.4.1 Write Operation



Ta=25°C, Vdd=5.0±0.5V

Item	Symbol	Min	Typ	Max	Unit
Enable cycle time	t_{cycE}	1200	-	-	ns
Enable pulse width (high level)	PW_{EH}	140	-	-	ns
Enable rise/fall time	t_{Er}, t_{Ef}	-	-	25	ns
Address set-up time (RS, R/W to E)	t_{AS}	0	-	-	ns
Address hold time	t_{AH}	10	-	-	ns
Data set-up time	t_{DSW}	40	-	-	ns
Data hold time	t_H	10	-	-	ns

12.2.4.2 Read Operation

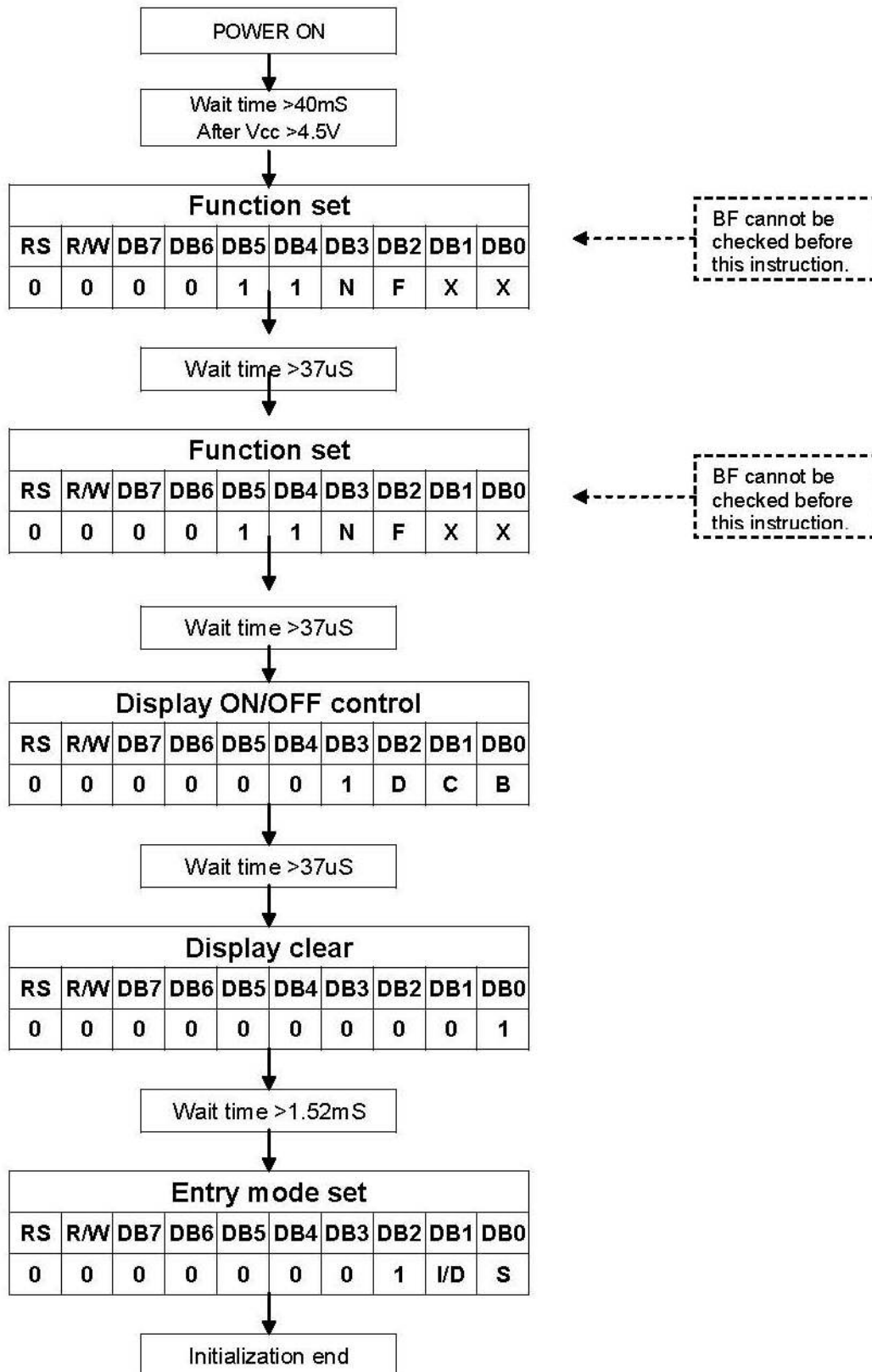


$T_a=25^{\circ}\text{C}, V_{dd}=5.0\pm 0.5\text{V}$

Item	Symbol	Min	Typ	Max	Unit
Enable cycle time	t_{cycE}	1200	-	-	ns
Enable pulse width (high level)	PW_{EH}	140	-	-	ns
Enable rise/fall time	t_{Er}, t_{Ef}	-	-	25	ns
Address set-up time (RS, R/W to E)	t_{AS}	0	-	-	ns
Address hold time	t_{AH}	10	-	-	ns
Data delay time	t_{DDR}	-	-	100	ns
Data hold time	t_{DHR}	10	-	-	ns

12-2.5 Initializing soft ware of LCM

12.2.5.1 8-bit interface



N

12.2.5.2 4-bit interface

