SPECIFICATIONS FOR OLED MODULE

MODEL NO.

BL2004ASERNJU68j$

VER.01

FOR MESSRS:

_____

ON DATE OF:

_____

APPROVED BY:

_____

BOLYMIN, INC.

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History of Version

Version	Contents	Date	Note
01	NEW VERSION	2018/2/22	SPEC.

C O N T E N T S

1. Numbering System

	B	L	2004	AS	E	R	N	J	U	68j$
	0	1	2	3	4	5	6	7	8	9

0	Brand	Bolymin	
1	Module Type	L=PLED/OLED	
2	Format	2004=20 characters, 4 lines 12232= 122 x 32 dots	
3	Version No.	AS type	
4	LCD Color	L=OLED/Green W=OLED/White K= OLED/Blue	E=OLED/Yellow R=OLED/Red
5	LCD Type	R=positive/reflective	
6	Backlight type/color	N=No backlight	
7	CGRAM Font (applied only on character type)	J=English/Japanese Font E=English/European Font B= English/Japanese/European	C=English/Cyrillic Font H=English/Hebrew Font A=English/Arabic Font
8	View Angle/ Operating Temperature	U=Bottom/Ultra wide Temperature	
9	Special Code	n=positive voltage for LCD	68j=6800 mode,8-bits 20c= I2C interface $=RoHS

2.General Specification

(1) Mechanical Dimension

Item	Standard Value	Unit
Number of Characters	20 characters × 4 Lines	dots
Module dimension (L*W*H)	98.0 x 60.0 x 4.0	mm
View area	72.42 x 22.82	mm
Active area	70.42 x 20.82	mm
Dot size	0.57 x 0.57	mm
Dot pitch	0.60 x 0.60	mm
Character size (L x W)	2.97 x 4.77	mm
Character pitch (L x W)	3.55x 5.35	mm

(2) Controller IC: Compatible with HD44780/ST7066U

3. Absolute Maximum Ratings

Item	Symbol	Condition	Min	Max	Unit
Operating Temperature	TOP		-40	+85	℃
Storage Temperature	TST		-40	+90	℃
Supply Voltage(Logic)	VDD		-0.3	5.6	V
Operating life time		50 cd/m²	180000		Hrs

※ VDD = 5.0V. Supply Voltage for Display generated by internal DC/DC convertor. T a = 25˚C.

※ Life time is defined the amount of time when the luminance has decayed to less than 50% of the initial measured luminance.

※ Life time should be counted once shipping out from our warehouse . But the exact lifetime must depend on customer's operation environment and application.

4. Electrical Characteristics

(Ta=25℃)

Item	Symbol	Condition	Min.	Typ.	Max.	Unit
Supply Voltage (VDD)	VDD	—	4.5	5.0	5.5	V
Input High Vol	V_{IH}	—	$0.7V_{DD}$	—	V_{DD}	V
Input Low Vol	V_{IL}	—	0	—	$0.3V_{DD}$	V
Output High Vol	V_{OH}	—	$0.7V_{DD}$	—	V_{DD}	V
Output Low Vol.	VOL	—	—	—	0.3VDD	V
Supply Current (*)	IDD	—	—	50	70	mA

※ VDD = 5.0V, 100% Display Area Turn on. Display color=Yellow. Supply Voltage for Display generated by internal DC/DC convertor.

5. Optical Characteristics

Item	Min.	Typ.	Max.	Unit
View Angle	—	Free	—	deg
Dark Room contrast	>10000:1			—
CIE x,y (Color: Yellow)	(0.43,0.45)	(0.47,0.49)	(0.51,0.53)	
Brightness (Note 1)	35	50		cd/m2

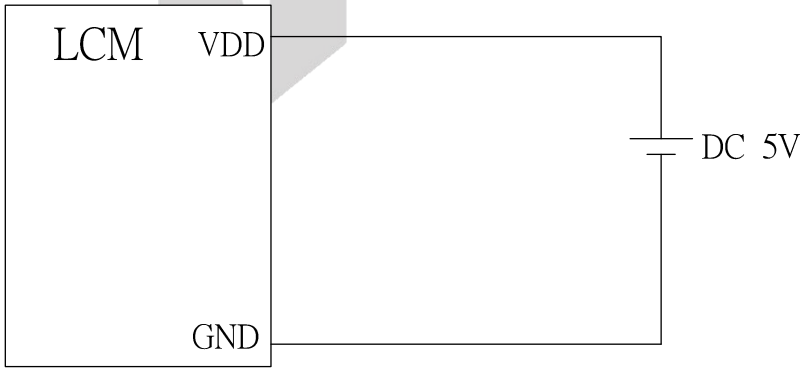
Note 1: VDD = 5.0V, 100% Display Area Turn on. Supply Voltage for Display generated by internal DC/DC convertor.

6.Interface Pin Function

Pin No	Symbol	Level	Description
1	GND	0V	Ground
2	VDD	5.0V	Supply Voltage for logic.
3	NC	-	No connection
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/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	NC	-	No connection
16	NC	-	No connection

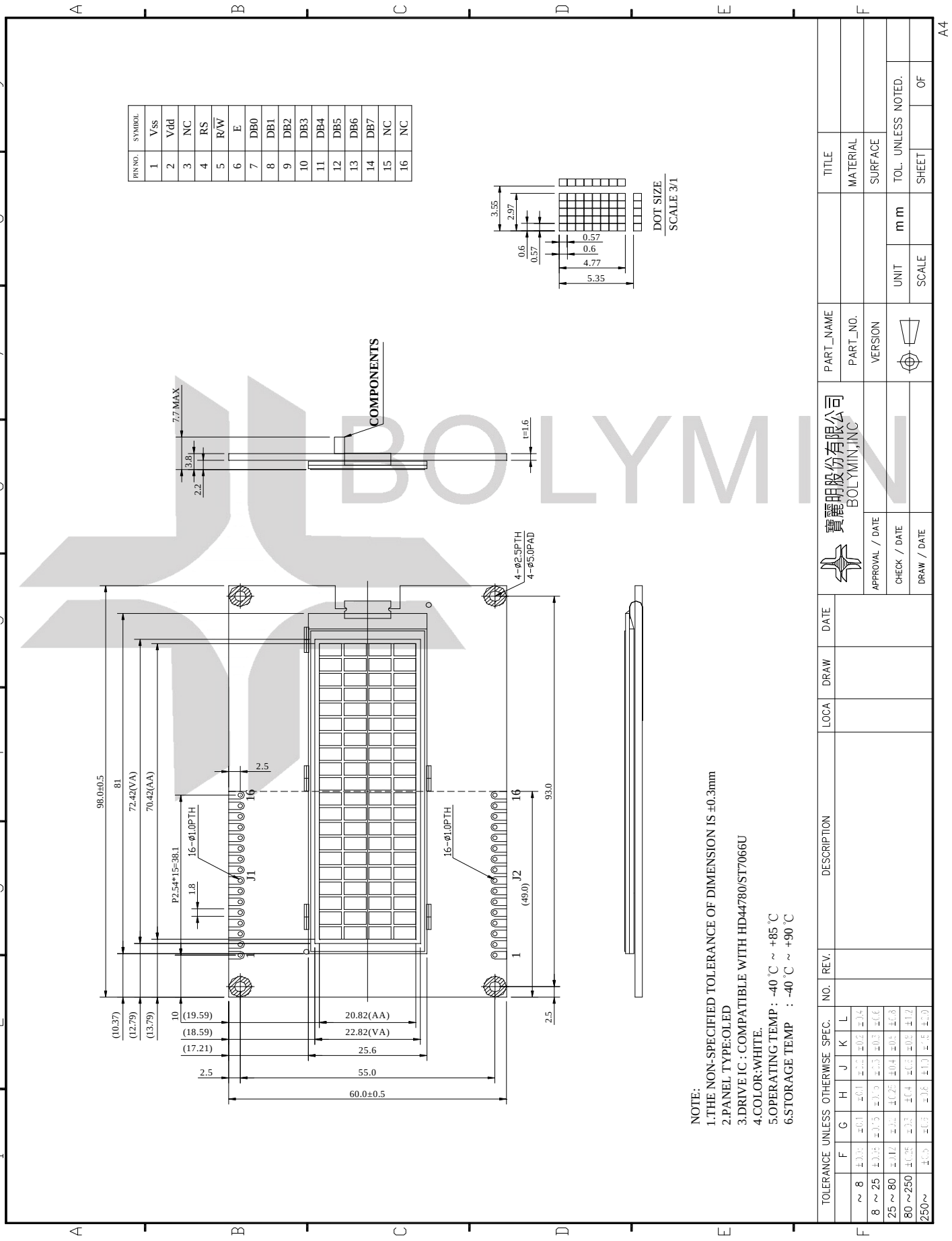
7.Power supply for LCD Module

＊LCM operating on "DC 5.0V " input with built-in positive voltage

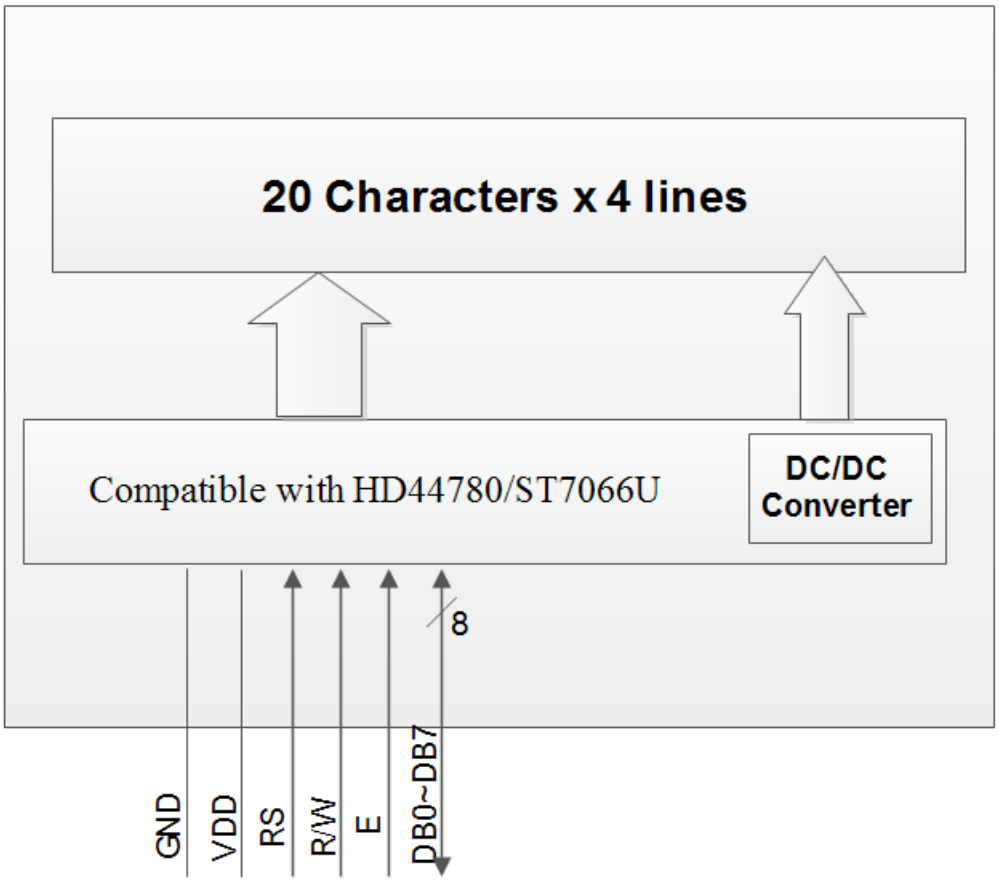


8. Drawing & Block Diagram

8.1 Drawing



8.2 BLOCK DIAGRAM



9. Controller Data

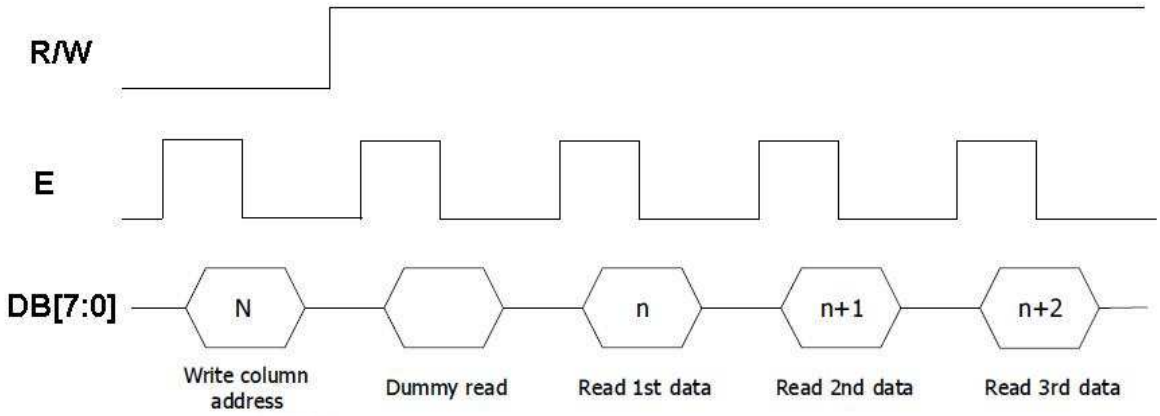
9.1 MPU Parallel 6800-series Interface

The parallel interface consists of 8 bi-directional data pins (DB[7:0]), R/W, RS, E.
A LOW in R/W indicates WRITE operation and HIGH in R/W indicates READ operation.
A LOW in RS indicates COMMAND read/write and HIGH in RS indicates DATA read/write.
The E input serves as data latch signal. Data is latched at the falling edge of E signal.

Function	E	R/W	RS
Write command	↓	L	L
Read status	↓	H	L
Write data	↓	L	H
Read data	↓	H	H

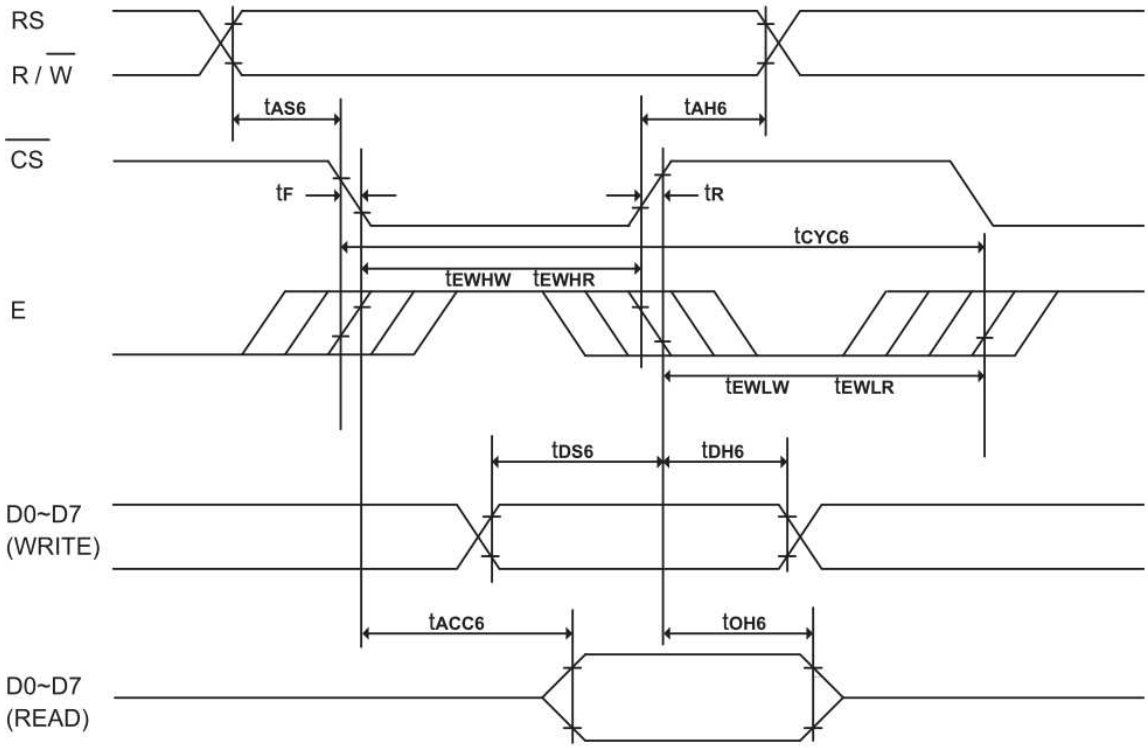
Control pins of 6800 interface

In order to match the operating frequency of display RAM with that of the microprocessor, some pipeline processing is internally performed which requires the insertion of a dummy read before the first actual display data read.



Data read back procedure - insertion of dummy read

9.2 System buses Read/Write Characteristics
(For the 6800 Series Interface MPU)



	Parameter	Min.	Typ.	Max.	Unit	Condition
tCYC6	System cycle time	500	-	-	ns	
tAS6	Address setup time	0	-	-	ns	
tAH6	Address hold time	0	-	-	ns	
tDS6	Data setup time	66	-	-	ns	
tDH6	Data hold time	25	-	-	ns	
tOH6	Output disable time	16	-	140	ns	CL = 100pF
tACC6	Access time	-	-	280	ns	CL = 100pF
tEWHW	Enable H pulse width (Write)	166	-	-	ns	
tEWHR	Enable H pulse width (Read)	200	-	-	ns	
tEWLW	Enable L pulse width (Write)	166	-	-	ns	
tEWLR	Enable L pulse width (Read)	166	-	-	ns	
tR	Rise time	-	-	25	ns	
tF	Fall time	-	-	25	ns	

9.3 Display Control Instruction

Instruction	Instruction Code										Description
	RS	R/W	DB7	DB6	DB5	DB4	DB3	DB2	DB1	DB0	
Clear Display	0	0	0	0	0	0	0	0	0	1	Clear entire display area.(POR = 01H)
Return Home	0	0	0	0	0	0	0	0	1	—	Counter with DDRAM address 00H. (POR = 10H)
Entry Mode Set	0	0	0	0	0	0	0	1	I/D	SH	Assign cursor moving direction and enable the shift of entire display.
Display ON/OFF Control	0	0	0	0	0	0	1	D	C	B	Set display (D), cursor (C), and blinking of cursor (B) on/off control bit. (POR = 08H)
Cursor or Display Shift	0	0	0	0	0	1	S/C	R/L	—	—	Shift display or move cursor..
Function Set	0	0	0	0	1	DL	N	F	—	—	Set number of display line (N), and character font (F). (POR = 30H)
Set CGRAM Address	0	0	0	1	AC5	AC4	AC3	AC2	AC1	AC0	Set CGRAM address in address counter.
Set DDRAM Address	0	0	1	AC6	AC5	AC4	AC3	AC2	AC1	AC0	Set DDRAM address in address counter.
Read Busy Flag and Address	0	1	BF	AC6	AC5	AC4	AC3	AC2	AC1	AC0	Read Busy Flag (BF) and Address Counter (POR = 00H)
Write Data to RAM	1	0	D7	D6	D5	D4	D3	D2	D1	D0	Write data to CG RAM or DD RAM. (POR= 00H)
Read Data from RAM	1	1	D7	D6	D5	D4	D3	D2	D1	D0	Read data from CG RAM or DD RAM. (POR = 00H)

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)

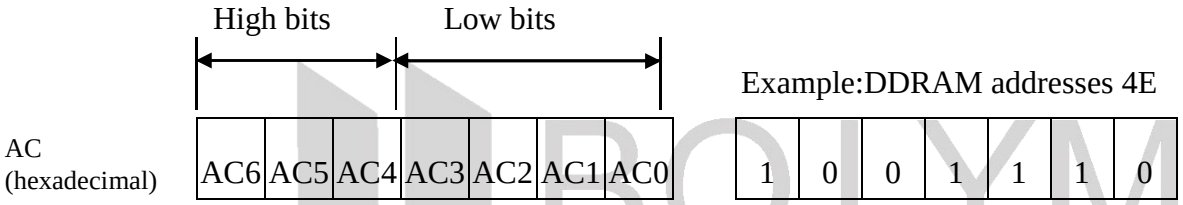
When the busy flag is 1, the controller LSI is in the internal operation mode, and the next instruction will not be accepted. When RS=0 and R/W=1, the busy flag is output to DB7. The next instruction must be written after ensuring that the busy flag is 0.

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	14	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
14	15	16	17	18	19	1A	1B	1C	1D	1E	1F	20	21	22	23	24	25	26	27
54	55	56	57	58	59	6A	6B	6C	6D	6E	6F	70	71	72	73	74	75	76	77

Example: 4-Line by 20-Character Display

Character Generator ROM (CGROM)

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

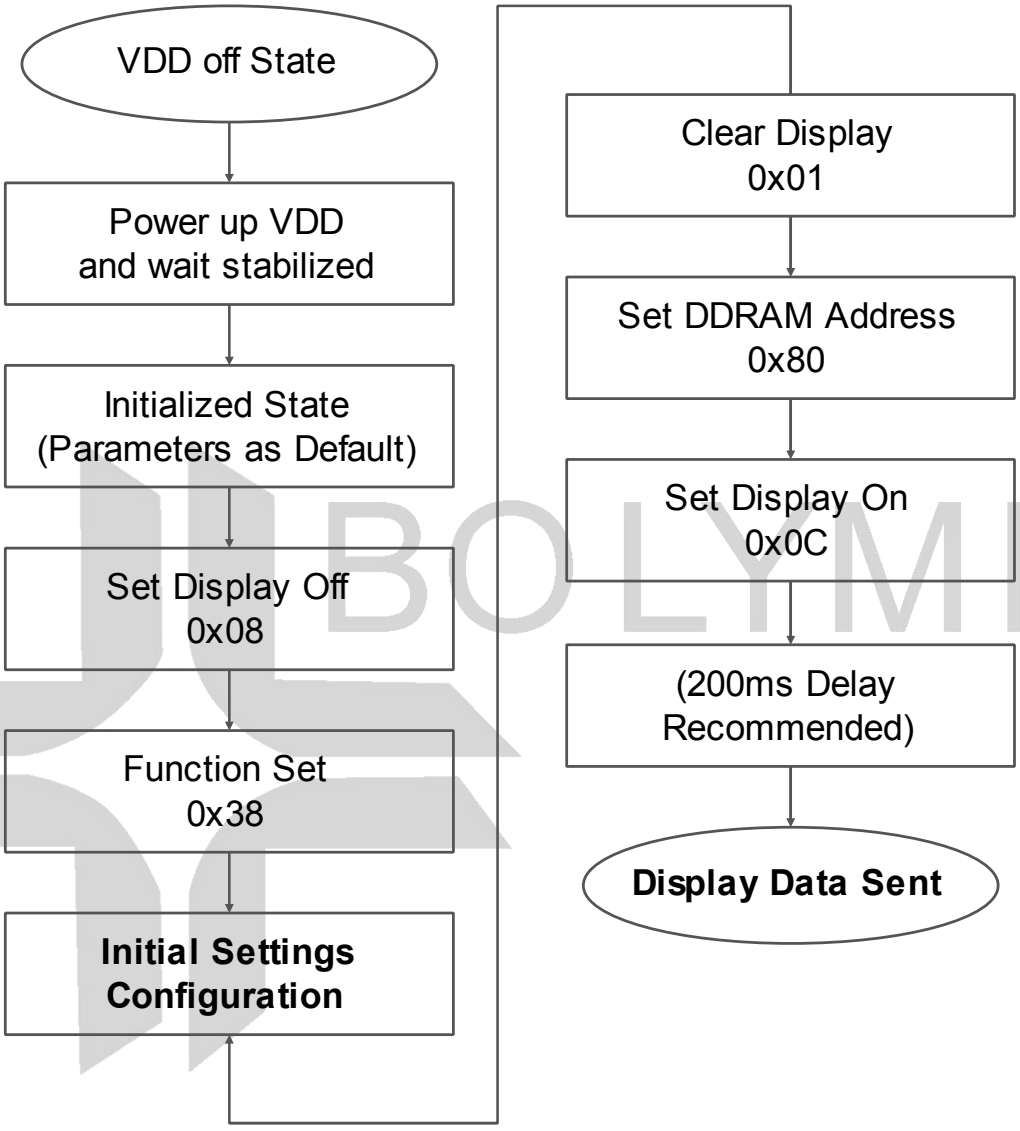
Character Generator RAM (CGRAM)

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

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.

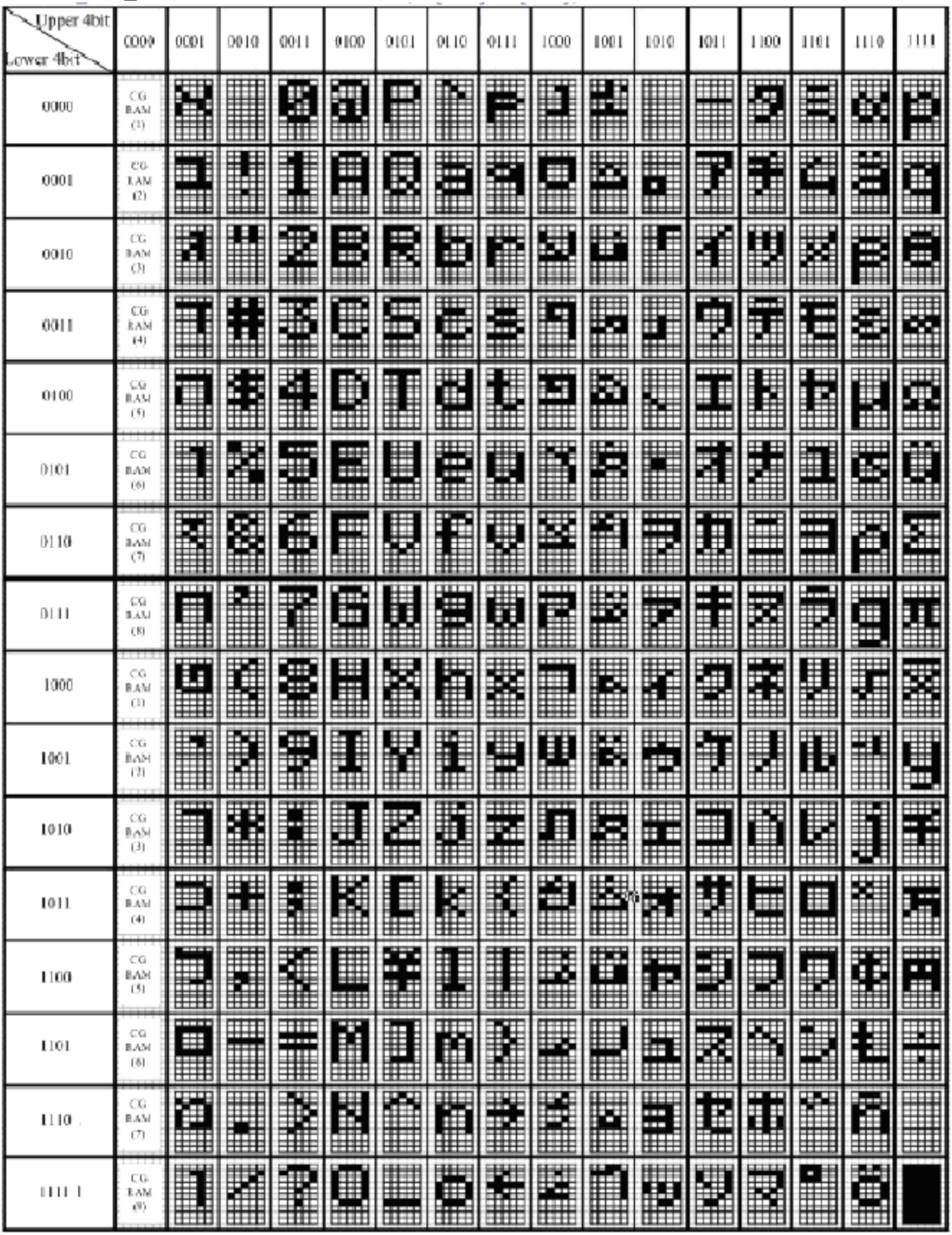
9.4 Initializing software of LCM

8-bit interface



10. Built-in CGROM (Character Generator ROM)

ENGLISH_JAPANESE CHARACTER FONT TABLE



11. Quality Assurance

11.1 Inspection conditions

1. The inspection and measurement are performed under the following conditions, unless otherwise specified.
2. Temperature: 25±5°C
3. Humidity: 50±10%R.H.
4. Distance between the panel and eyes of the inspector ≧30cm

11.2 Inspection Parameters

Severity	Inspection Item	Defect	Remark
Major Defect	1. Panel	(1) Non-displaying	
		(2) Line defects	
		(3) Malfunction	
		(4) Glass cracked	
	2. Film	(1) Film dimension out of specification	Can not be assembled
	3. Dimension	(1) Outline dimension out of specification	
Minor Defect	1. Panel	(1) Glass scratch	Appearance defect
		(2) Glass cutting NG	
		(3) Glass chip	
	2. Polarizer	(1) Polarizer scratch	
		(2) Stains on surface	
		(3) Polarizer bubbles	
	3. Displaying	(1) Dim spot、Bright spot、dust	
	4. Film	(1) Damage (2) Foreign material	

<table>
<tr><th>Description</th><th>Criterion</th><th>AQL</th></tr>
<tr><td>1. Glass scratch</td><td>
<table>
<tr><th>Width (mm)
W</th><th>Length (mm)
L</th><th>number of pieces permitted</th></tr>
<tr><td>W≦0.1
W>0.1

beyond A.A.</td><td>Ignore
L≦2
L > 2
Ignore</td><td>Ignore
n=1
n=0</td></tr>
</table>
</td><td>2.5</td></tr>
<tr><td>2. Polarizer bubble</td><td>
<table>
<tr><th>Size</th><th>number of pieces permitted</th></tr>
<tr><td>Φ ≦0.5
Φ>0.5
beyond A.A.</td><td>Ignore
0
Ignore</td></tr>
</table>
</td><td>2.5</td></tr>
<tr><td>3. Dimming spot、
Lighting spot、
Dust</td><td>
<table>
<tr><th>average</th><th>number of</th></tr>
<tr><td>D ≦0.1
0.1＜ D ≦0.25
0.25＜ D
beyond A.A.</td><td>Ignore
1
0
Ignore</td></tr>
</table>
D=(long diameter + short diameter)/2.
Pixel off is not allowed.
</td><td>2.5</td></tr>
</table>

11.3 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.

11.4 MTBF

11.4.1 .MTBF based on specific test condition is 100K hours.

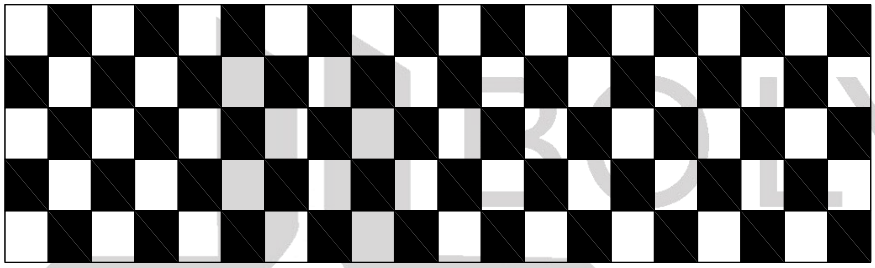
11.4.2 Test Condition:

11.4.2.1 Supply Voltage: VCC=12.0V

11.4.2.2 Luminance: <35 cd/m^2 .

11.4.2.3 Operation temperature and humidity :< 25℃ and 50%RH

11.4.2.4 Run-Patterns:



11.4.3 Test Criteria:

Luminance has decayed to less than 50% of the initial measured luminance.

12.Reliability

■**Content of Reliability Test**

NO.	Items.	Specification	Applicable Standard
1	High temp. (Non-operation)	90°C, 120hrs	——
2	High temp. (Operation)	85°C,120hrs	——
3	Low temp. (Non-Operation)	-40°C, 120hrs	——
4	Low temp. (Operation)	-40°C, 120hrs	——
5	High temp. / High. humidity (Operation)	60°C, 90%RH, 96hrs	——
6	Thermal shock(Non-operation)	-40°C ~85°C,100 cycles. 60 mins dwell	——

Test and measurement conditions

1. The degradation of Polarizes are ignored.
2. No moisture condensation is observed during tests.

Failure Check Standard

After the completion of the described reliability test, the samples were left at room temperature for 2hrs prior to conducting the failure test at 23±5°C; 55±15% RH.

Criteria

1. The function test is OK.
2. No observable defects.
3. Luminance: >50% of initial value.
4. Current consumption: within ±50% of initial value.

Reliability Test

Bolymin only guarantees the reliability of the panel under the test conditions and durations listed in the specification, and is not responsible for any test results that are conducted using more stringent conditions and/or with lengthened durations. Also, when the testing the panel in a chamber or oven, make sure they won't produce any condensation on the panel, especially on the electrical leads, before lighting on the panel to see if it passes the test. Also the panel should rest for about an hour at room temperature and pressure before the measurement, as indicated in the specification. Be aware that one should use fresh panel for each of the reliability test items listed in the specification, in other words, don't use the panels that were tested for subsequent tests.

13. Precautions for Handling

1) Since the display panel is being made of glass, do not apply mechanical impacts such us dropping from a high position.
2) If the display panel is broken by some accident and the internal organic substance leaks out, be careful not to inhale nor lick the organic substance.
3) If pressure is applied to the display surface or its neighborhood of the OEL display module, the cell structure may be damaged and be careful not to apply pressure to these sections.
4) The polarizer covering the surface of the OEL display module is soft and easily scratched. Please be careful when handling the OEL display module.
5) When the surface of the polarizer of the OEL display module has soil, clean the surface. It takes advantage of by using following adhesion tape.
   * Scotch Mending Tape No. 810 or an equivalent
   Never try to breathe upon the soiled surface nor wipe the surface using cloth containing solvent such as ethyl alcohol, since the surface of the polarizer will become cloudy.
   Also, pay attention that the following liquid and solvent may spoil the polarizer:
   * Water
   * Ketone
   * Aromatic Solvents
6) Hold OEL display module very carefully when placing OEL display module into the system housing. Do not apply excessive stress or pressure to OEL display module. And, do not over bend the film with electrode pattern layouts. These stresses will influence the display performance. Also, secure sufficient rigidity for the outer cases.
7) Do not apply stress to the driver IC and the surrounding molded sections.
8) Do not disassemble nor modify the OEL display module.
9) Do not apply input signals while the logic power is off.
10) Pay sufficient attention to the working environments when handing OEL display modules to prevent occurrence of element breakage accidents by static electricity.
    * Be sure to make human body grounding when handling OEL display modules.
    * Be sure to ground tools to use or assembly such as soldering irons.
    * To suppress generation of static electricity, avoid carrying out assembly work under dry environments.
    * Protective film is being applied to the surface of the display panel of the OEL display module. Be careful since static electricity may be generated when exfoliating the protective film.
11) Protection film is being applied to the surface of the display panel and removes the protection film before assembling it. At this time, if the OEL display module has been stored for a long period of time, residue adhesive material of the protection film may remain on the surface of the display panel after removed of the film. In such case, remove the residue material by the method introduced in the above Section 5).
12) If electric current is applied when the OEL display module is being dewed or when it is placed under high humidity environments, the electrodes may be corroded and be careful to avoid the above.

14. Precautions for Electrical

14.1. Design using the settings in the specification

It is extremely important to design and operate the panel using the settings listed in the specification. This includes voltage, current, frame rate, duty cycle... etc. Operation of the OLED outside the specified range in the specification should be entirely avoided to ensure proper operation of the OLED.

14.2. Maximum Ratings

To ensure proper operation of the panel, never design the panel with parameters running over the maximum ratings listed in the specification. Also the logic voltages such as VIL and VIH have to be within the specified range in the specification to prevent any improper operation of the panel.

14.3 Power on/off procedure

Any operation that does not comply with the procedure could cause permanent damage of the IC and should be avoided. When the logic power is not on, do not activate any input signal. Abrupt shutdown of power to the module, while the OLED panel is on, could cause OLED panel mal-functioning.

14.4 Power savings

To save power consumption of the OLED, one can use partial display or sleep mode when the panel is not fully activated. Also, if possible, make maximum use of black background to save power. The OLED is a self-luminous device, and a particular pixel cluster or image can be lit on via software control, so power savings can be achieved by partial display or dimming down the luminance. Depending on the application, the user can choose among Ultra Bright Mode, Normal Operation Mode, and Sleeping Mode.

The power consumption is almost in direct proportion to the brightness of the panel, and also in direct proportion to the number of pixels lit on the panel, so the customer can save the power by the use of black background and Sleeping Mode. One benefit from using these design schemes is the extension of the OLED lifetime.

14.5 Residual Image (Image Sticking)

The OLED is a self-emissive device. As with other self-emissive device or displays consisting of self-emissive pixels, when a static image frozen for a long period of time is changed to another one with all-pixels-on background, residual image or image sticking is noticed by the human eye. Image sticking is due to the luminance difference or contrast between the pixels that were previously turned on and the pixels that are newly turned on. The time when image sticking happens depends on the luminance decay curve of the display. The slower the decay, the less prominent the image sticking is. It is strongly recommended that the user employ the following three strategies to minimize image sticking

14.5.1 Employ image scrolling or animation to even out the lit-on time of each and every pixel on the display, also could use sleeping mode for reduced the residual image and extend the power capacity.

14.5.2 Minimize the use of all-pixels-on or full white background in their application because when the panel is turned on full white, the image sticking from previously shown patterns is the most revealing. Black background is the best for power savings, greatest visibility, eye appealing, and dazzling displays

14.5.3 If in the reliability test when a static logo is used, change the pattern into its inverse (i.e., turn off the while pixels and turn on the previously unlit pixels) and freeze the inverse pattern as long as the original logo is used, so every pixel on the panel can be lit on for about the same time to minimize image sticking, caused by the differential turn-on time between the original and its reverse patterns

15. Precautions for Storage

Although the storage conditions and guarantee period are indicated in the specification, it is advisable to store the packed cartons or packages at 23℃±5℃,55%±10%RH(Note A), Do not store the OLED module under direct sunlight or UV light and for best panel performance.The constant working OLED display module decays slower than the module that is not working. And it's better to use the module on the field within one month after unpacking the package.

Note (A):

Vacuum Packaging

Desiccant x 2

Humidity indicator card

Humidity indicator card

As the humidity increases, the chemically impregnated spots change from a brown color (DRY) to a blue color (HUMID).