# SPECIFICATIONS FOR OLED MODULE

**MODEL NO.**
**BL2004AM-ERNJU20I$**
**VER.01**

FOR MESSRS:

_____

ON DATE OF:

_____

APPROVED BY:

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**BOLYMIN, INC.**
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## History of Version

| Version | Contents | Date | Note |
|---|---|---|---|
| 01 | NEW VERSION | 2020/1/3 | SPEC. |
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**C O N T E N T S**

# 1. Numbering System

| B | L | 2004 | AM | - | E | R | N | J | U | 20I | $ | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 0 | 1 | 2 | 3 | | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 |

| | | | | | |
|---|---|---|---|---|---|
| 0 | Bolymin | B | | | |
| 1 | Module Type | L | OLED | | |
| 2 | Format | 2004 | 20 character type,4lines | | |
| 3 | Version No. | AM | | | |
| | - | | | | |
| 4 | LCD Color | L | OLED/Green | E | OLED/Yellow |
| | | W | OLED/White | R | OLED/RED |
| | | K | OLED/BLUE | | |
| 5 | LCD Type | R | Positive/reflective | | |
| 6 | Backlight type/color | N | No backlight | | |
| 7 | CGRAM Font | J | English/Japanese Font | E | English/European Font |
| | | B | English/Japanese/European | C | English/Cyrillic Font |
| 8 | View Angle /Operation Temperature | U | 6:00/Ultra wide Temperature | H | 6:00 /Wide Temperature |
| | | | | | |
| 9 | Special Code | 3 | 3 voltage logic power supply | N | Positive voltage for LCD |
| | | 20K | RS 232 I/F | 20C | I2C I/F |
| | | 20I | SPI I/F | 68J | 6800 mode,8-bits |
| | | 68K | 6800 mode,4-bits | 80J | 8080 mode,8-bits |
| | | 80K | 8080 mode,4-bits | | |
| 10 | RoHS | $ | | | |
| 11 | Customer Code | 00 0 ~ 99 0 、AA 0 ~ ZZ 0 | | | |

## 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 13.1 | mm |
| View area | 76.0 x 24.2 | 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 ) | 3.55 x 5.35 | mm |

(2) Controller IC: Compatible with PT0066
IC Equivalent (compatible) HD44780, KS0066 , SPLC780 , ST7066 , AIP31066

## 3.Absolute Maximum Ratings

| Item | Symbol | Condition | Min | Typ. | Max | Unit |
|---|---|---|---|---|---|---|
| Operating Temperature | TOP | | -40 | --- | +80 | ℃ |
| Storage Temperature | TST | | -40 | --- | +90 | ℃ |
| Supply Voltage(Logic) | VDD | | -0.3 | --- | 5.5 | V |
| Input Voltage | VI | | -0.3 | --- | 5.5 | V |
| Operating life time | | 80cd/m² | --- | 100000 | --- | Hrs |

Note 1: All the above voltages are on the basis of “VSS = 0V”.
Note 2: When this module is used beyond the above absolute maximum ratings, permanent breakage of the module may occur.
Note 3:Ta = 25℃, 25% Checkerboard.
Software configuration follows section actual application example Initialization.
End of lifetime is specified as 50% of initial brightness reached. The average operating lifetime at room temperature is estimated by the accelerated operation at high temperature conditions..

## 4.Electrical Characteristics

(Ta=25℃)

| Item | Symbol | Condition | Min. | Typ. | Max. | Unit |
|---|---|---|---|---|---|---|
| Supply Voltage (VDD) | VDD | — | 2.8 | 5.0 | 5.3 | 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. | $V_{OL}$ | — | — | — | 0.3VDD | V |
| Supply Current (*) | IDD | — | — | 40 | — | mA |

Note : VDD=5.0V, 25% Display Area Turn on 100 cd/m2.
When random texts pattern is running, averagely, about 1/4 of pixels will be on.

## 5.Optical Characteristics

| Item | Min. | Typ. | Max. | Unit |
|---|---|---|---|---|
| View Angle | — | Free | — | deg |
| Dark Room contrast | >10000:1 | | | — |
| CIE x,y (Color: Yellow) | (0.46,0.45) | (0.50,0.49) | (0.54,0.53) | |
| Brightness | — | 100 | — | cd/m2 |

# 6.Interface Pin Function

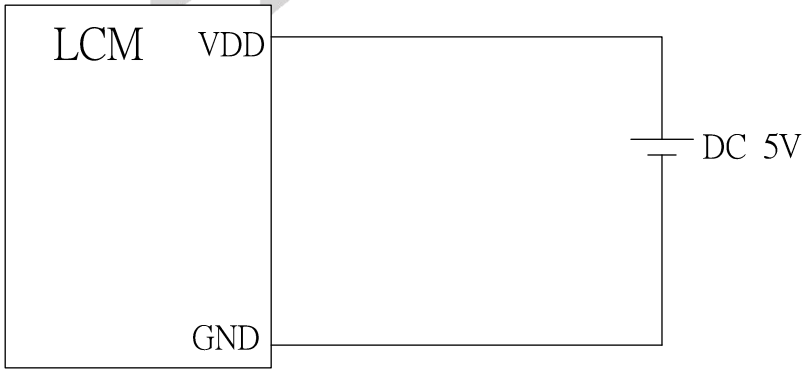
**IF1:**

| | | | |
|---|---|---|---|
| 1 | GND | 0V | Ground |
| 2 | VDD | 5.0V | Supply Voltage for logic**.** |
| 3 | NC | - | No connection |
| 4 | RS | H/L | This is the Data/Command control pad that determines whether the data bits are data or a command.<br>RS = “H”:treated as display data.<br>RS = “L”:transferred to the command registers. |
| 5 | NC | - | No connection. |
| 6 | NC | - | No connection. |
| 7 | SCL | H/L | Serial clock input |
| 8 | SI | H/L | Serial data input |
| 9 | NC | - | No connection. |
| 10 | NC | - | No connection. |
| 11 | NC | - | No connection. |
| 12 | NC | - | No connection. |
| 13 | NC | - | No connection. |
| 14 | NC | - | No connection. |
| 15 | NC | - | No connection |
| 16 | NC | - | No connection |

※SPI Series Interface is Default

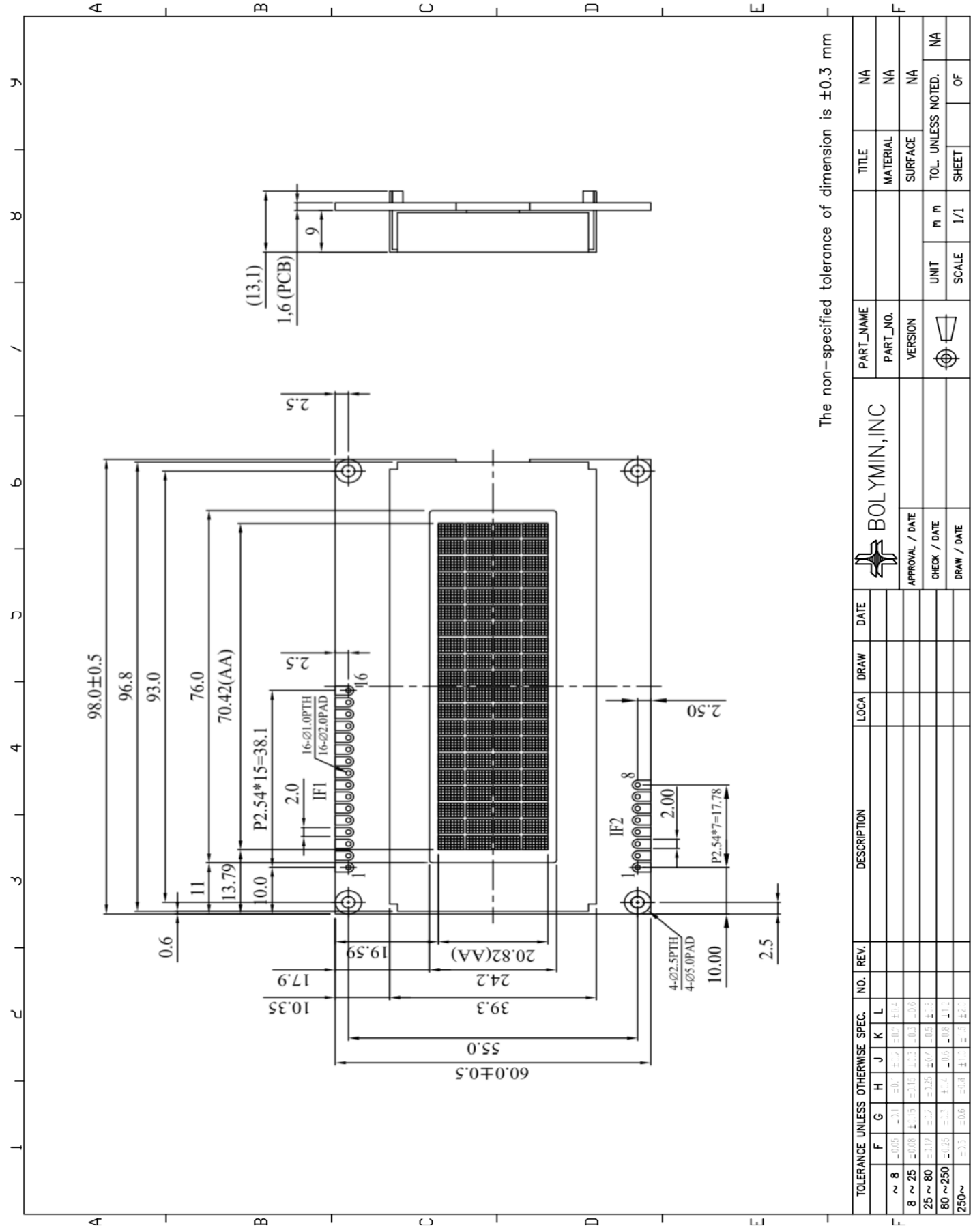
# 7.Power supply for LCD Module

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



# 8.Drawing& Block Diagram

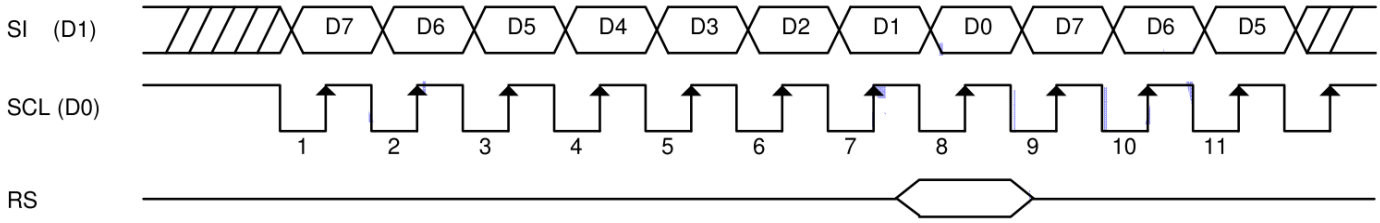
## 8.1 Drawing



# 9. Controller Data

9.1 4 Wire Serial Interface (4-wire SPI)

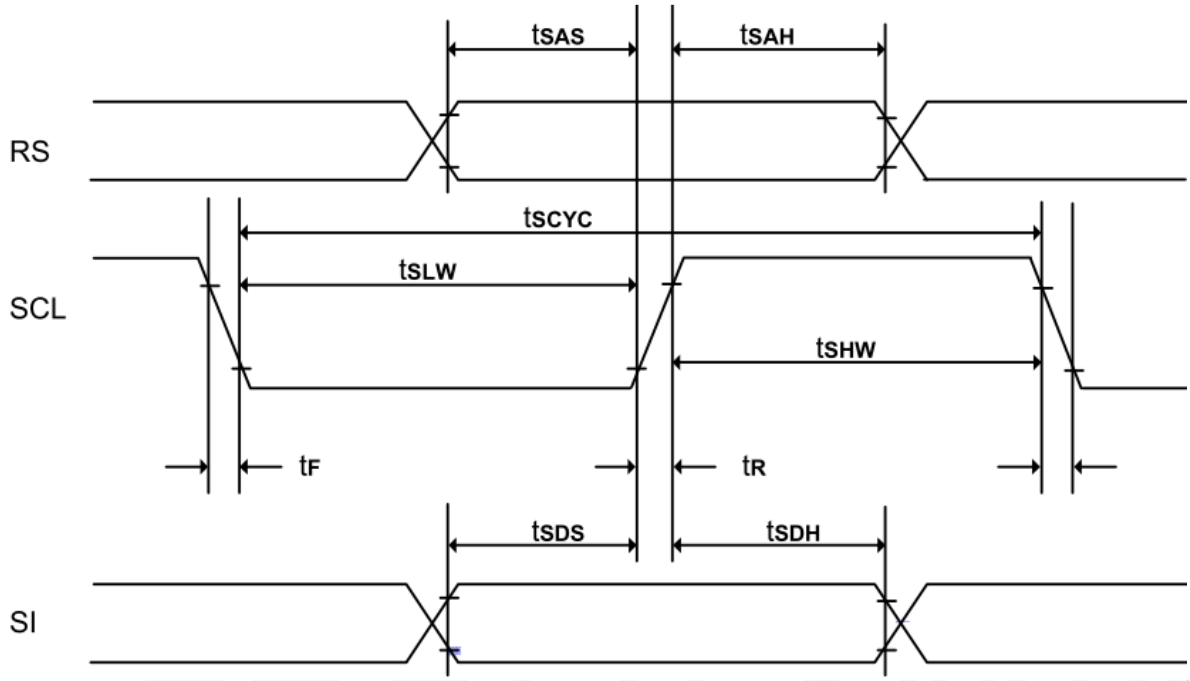
The serial interface consists of serial clock SCL, serial data SI, RS .SI is shifted into an 8-bit shift register on every rising edge of SCL in the order of D7, D6, … and D0. A0 is sampled on every eighth clock and the data byte in the shift register is written to the display data RAM or command register in the same clock.




- When the chip is not active, the shift registers and the counter are reset to their initial statuses.
- Read is not possible while in serial interface mode.
- Caution is required on the SCL signal when it comes to line-end reflections and external noise. We recommend theoperation be rechecked on the actual equipment.

## 9.2 System buses Read/Write Characteristics

4-wire SPI interface characteristics




| | Parameter | Min. | Typ. | Max. | Unit | Condition |
|---|---|---|---|---|---|---|
| tSCYC | Serial clock cycle | 500 | - | - | ns | |
| tSAS | Address setup time | 300 | - | - | ns | |
| tSAH | Address hold time | 300 | - | - | ns | |
| tSDS | Data setup time | 200 | - | - | ns | |
| tSDH | Data hold time | 200 | - | - | ns | |
| tSHW | Serial clock H pulse width | 200 | - | - | ns | |
| tSLW | Serial clock L pulse width | 200 | - | - | ns | |
| tR | Rise time | - | - | 30 | ns | |
| tF | Fall time | - | - | 30 | 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)**

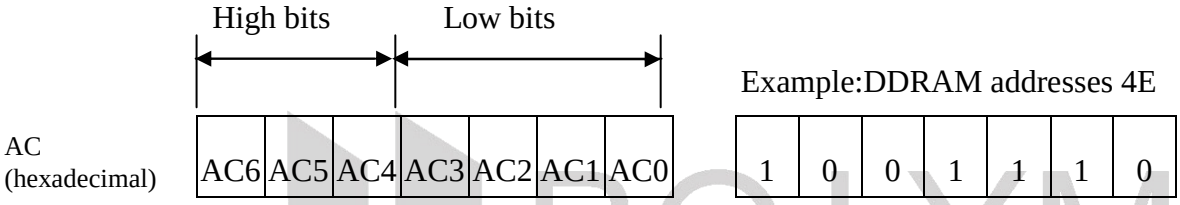
When the busy flag is 1, the controller LSI is in the internal operation mode, and the next instruction will not be accepted. When RS=0 and R/W=1, the busy flag is output to DB7. The next instruction must be written after ensuring that the busy flag is 0.

**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 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 00 | 01 | 02 | 03 | 04 | 05 | 06 | 07 | 40 | 41 | 42 | 43 | 44 | 45 | 46 | 47 |

Example: 1-Line by 16-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.

# 10. Built-in CGROM (Character Generator ROM)

## ENGLISH_JAPANESE