





| FOR MESSRS: | | |
|--------------|--|---|
| ON DATE OF: | | |
| APPROVED BY: | | _ |

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History of Version

| Version | Contents | Date | Note |
|---------|-------------|-------------|-------|
| 01 | NEW VERSION | 2019/10/30 | SPEC. |
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1. Numbering System

| В | С | 1602 | Α | ı | F | Р | Н | Е | Н | ı | \$ | |
|---|---|------|---|---|---|---|---|---|---|---|----|----|
| 0 | 1 | 2 | 3 | | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 |

| 0 | Bolymin | В | | | | | | |
|---|-------------|--------|------------------------|---------------------|--|------------------------|--|--|
| | | С | Character t | уре | Р | TAB /TCP type | | |
| | | F | COF type | | | Color STN | | |
| 1 | Module Type | G | Graphic typ | oe e | L | OLED | | |
| | | 0 | COG type | | Z | Customize | | |
| | | | | | | | | |
| | _ | | 2004 | 20 character type,4 | lines | | | |
| 2 | Format | | 12232 | 122 × 32 dots | | | | |
| 3 | Version No. | | A~Z (A1~Z9 | AA~ZZ) type (F | RW10 | 63 IC AW=I2C AR=SPI) | | |
| | VI. | | | | | IMIMI | | |
| | | В | STN / Blue | , OLED/Blue | Н | HTN | | |
| | | С | Color | | Т | TN | | |
| | | F | FSTN | | Υ | STN/Yellow-green | | |
| | | G | STN/Grey | | D | OLED/Blue+Yellow | | |
| 4 | LCD Color | Α | OLED/Blue+Yellow+Green | | | OLED/Yellow | | |
| | | L | OLED/Green | | | OLED/RED | | |
| | | W | OLED/White | | | ASTN | | |
| | | K | DFSTN | | V | VA LCD | | |
| | | | | | | | | |
| | LOD Turns | R | Positive/ref | lective | М | Positive/ transmissive | | |
| 5 | LCD Type | Р | Positive/tra | nsflective | N | Negative/ transmissive | | |
| | | Т | Negative/ to | ransflective | | | | |
| | | L | (LED)Array/ye | ellow-green | G | (LED)Edge/yellow-green | | |
| | | М | (LED)Array/ai | | Н | (LED)Edge/white | | |
| | | R | (LED)Array/re | | D | (LED)Edge/blue | | |
| | | U W | (LED)Array/bl | | E B | (EL)White | | |
| | Backlight | | (LED)Array/w | | F | (EL)blue | | |
| 6 | type/color | С | (CCFL) White | | | (LED)Array/RGB | | |
| | | Y | (LED)Array/ye | | N | No backlight | | |
| | | 0 | (LED)Array/o | | K | (LED)Edge/green | | |
| | | A J | (LED)Edge/ar | | Q | (LED)Edge/red | | |
| | | | (LED)Array/gi | | <u> </u> | (LED)Edge/RGB | | |
| | | Z | (LED) array re | ea/green | Р | (LED)Edge/orange | | |



| | | S | (LED)edge/RGW | Т | (LED)edge red/green |
|--|--------------------------|----|--|-----|---|
| | | V | EL blue/green | Х | (LED) Edge white / red |
| | | J | English/Japanese Font | С | English/Cyrillic Font |
| | | G | Chinese(simple) | Н | English/Hebrew Font |
| | | Е | English/European Font (ST7066U0B-BB) | S | English/European Font (ST7066U-0E-BB) |
| 7 | CGRAM Font | F | Chinese(traditional) | М | Japanese-Kanji |
| | | Z | Z=Chinese(simple)+Chinese (traditional)+Japanese+Korean | K | Korean (only for BG16032A BG24064C) |
| | | Α | English/Arabic Font | D | Chinese (simple/traditional) English/Japanese |
| | | В | English/Japanese/European | N | None |
| | | В | Bottom/Normal Temperature06:00 | W | Top/Wide Temperature 12:00 |
| | | Н | Bottom/Wide Temperature 06:00 | Е | Top/Ultra Temperature 12:00 |
| 8 | View Angle /Operation | С | 9H/Normal Temperature 09:00 | U | Bottom/Ultra wide Temperature 06:00 |
| | Temperature | Т | Top/Normal Temperature 12:00 | F | 9H/Ultra wide Temperature 09:00 |
| | | G | 3H/Wide Temperature 3:00 | D | 9H/Wide Temperature 09:00 |
| | | 1/ | 3H/ Ultra Wide Temperature 3:00 | | |
| 9 | Special Code | N | Negative voltage for LCD | Т | Negative voltage and Temperature compensation for LCD |
| | | | Touch panel | 3/5 | 3/5 voltage logic power supply |
| 10 | RoHS | \$ | | | |
| 11 | | | | | |
| <u> </u> | | | <u> </u> | | |



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°C±10°C 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°C±10°C.

 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 °C) 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°C) 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^oC 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: ≤ 50%

Increasing of current consumption for LCM/Backlight: ≤ 20%

Display function at room temperature: Normal

Appearance: Normal



3. General Specification

(1) Mechanical Dimension

| Item | Dimension | Unit | |
|-----------------------------------|-----------------------|------|--|
| Number of Characters | 16characters x2 Lines | _ | |
| Module dimension (L x W x H) | 1 | | |
| View area | 66.0x16.0 | mm | |
| Active area | 56.21x 11.5 | mm | |
| Dot size | 0.55x 0.65 | mm | |
| Dot pitch | 0.60 x 0.70 | mm | |
| Character size (L x W) | 2.95 x 5.55 | mm | |
| Character pitch (L x W) | 3.55 x 5.95 | mm | |

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

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 | Vdd-10.0 | Vdd+0.3 | V |
| Input Voltage | VI | -0.3 | Vdd+0.3 | V |



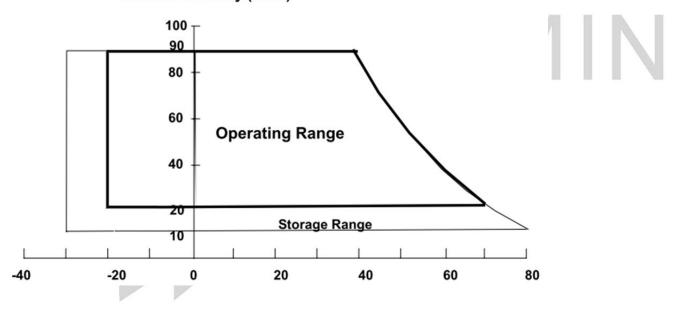
4.2 Environmental Absolute Maximum Ratings

| Item | Symbol | Min | Max | Unit | Note |
|-----------------------|--------|-----|-----|------------------------|------|
| Operating Temperature | TOP | -20 | 70 | $^{\circ}\!\mathbb{C}$ | (1) |
| Storage Temperature | TST | -30 | 80 | $^{\circ}\!\mathbb{C}$ | (1) |

Note (1)

- (a) 90 %RH Max. (Ta <= 40 °C).
- (b) Wet-bulb temperature should be 39 °C Max. (Ta > 40 °C).
- (c) No condensation.

Relative Humidity (%RH)





5. Electrical Characteristics

| Item | Symbol | Condition | Min | Тур | Max | Unit |
|---------------------------------|-----------------|---|---------|-----|---------|-------------------|
| Supply Voltage For Logic | Vdd-Vss | - | 4.75 | - | 5.25 | V |
| Supply Voltage For LCD | Vdd-Vo | Ta=25°ℂ | 3.7 | 4.0 | 4.3 | V |
| Input High Volt. | V _{IH} | - | 0.7Vdd | - | Vdd | V |
| Input Low Volt. | V_{IL} | - | -0.3 | - | 0.6 | V |
| Output High Volt. | V _{OH} | - | 0.9 Vdd | - | Vdd | V |
| Output Low Volt. | V _{OL} | - | - | - | 0.1 Vdd | V |
| Supply Current | ldd | Vdd=5.0V | - | 1.2 | - | mA |
| LCM Surface Luminance Ta=25℃ | L_ | I _{LED} =13mA Display all off | 35 | 52 | | cd/m ² |

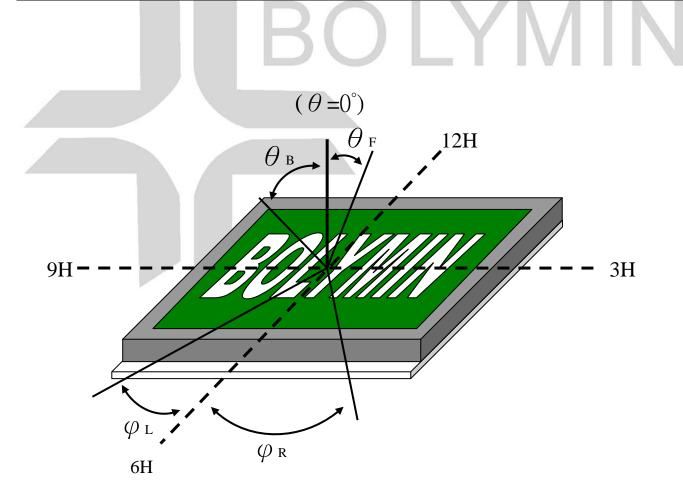
^{*}Optimum LCD driving voltage value, referring to above mentioned range, is changed due to different batch of LCD glass.



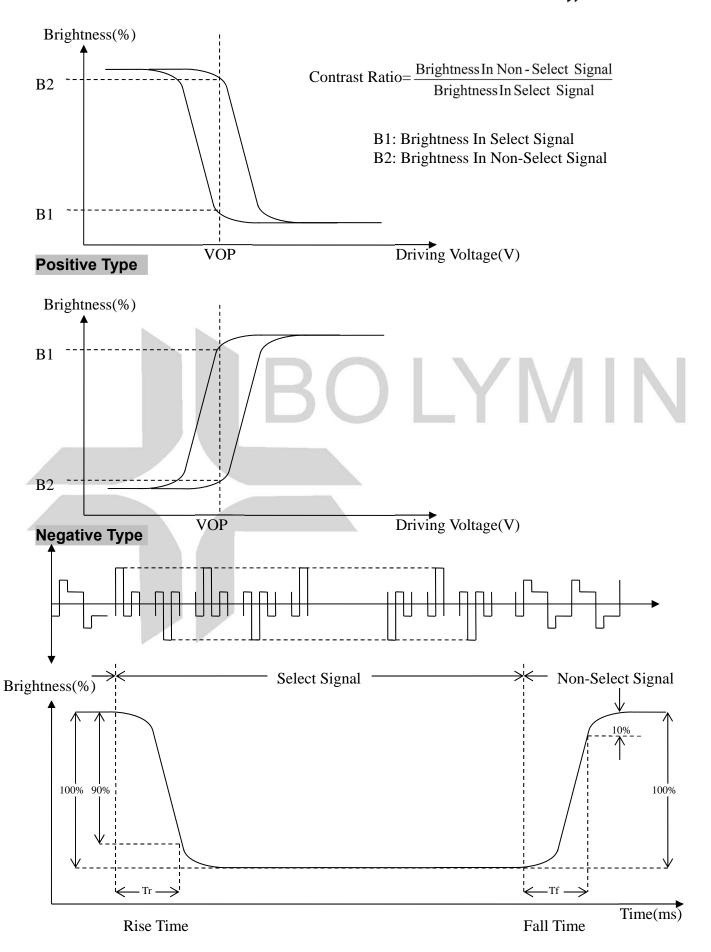
6. Optical Characteristics

a. FSTN (Ta=25°ℂ)

| Item | Symbol | Min. | Тур. | Max. | Unit |
|--------------------|-----------------------|------|------|------|------|
| | heta f | - | 50 | - | deg |
| | heta B | - | 61 | - | deg |
| View Angle (CR>=2) | <i>φ</i> _L | - | 53 | - | deg |
| | arphi R | - | 40 | - | deg |
| Contrast Ratio | CR | - | 5 | - | - |
| Decrease Time 25°C | T rise | - | 200 | 350 | ms |
| Response Time25°C | T fall | - | 200 | 400 | ms |









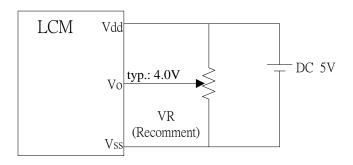
7. Interface Pin Function

| Pin No. | Symbol | Level | Description |
|---------|--------|------------|---|
| 1 | Vss | 0V | Ground |
| 2 | Vdd | 5.0V | Supply Voltage for logic (option +3.3V) |
| 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 | Α | _ | Power supply for LED backlight (+) / Negative voltage output (optional) |
| 16 | K | _ | Power supply for LED backlight (GND) |



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

* Standart Type



9. Backlight information

9.1 Specification

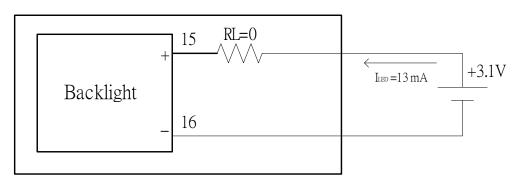
(1) LED edge / white

| _ , | | H | | | Λ | |
|-----------------|--------|------|-----|------|-----------|----------------|
| Parameter | Symbol | Min | Тур | Max | Unit | Test Condition |
| Supply Current | ILED | | 13 | | mA | V=3.1V |
| Supply Voltage | V | 2.8 | 3.1 | 3.3 | V | ILED=13mA |
| Reverse Voltage | VR | _ | _ | 5 | ٧ | |
| CIE | X | 0.27 | | 0.31 | | |
| | Υ | 0.27 | | 0.31 | | ILED=13mA |
| Color | | | WI | nite | | |

9.2 Backlight driving methods

- a. LED B/L drive from pin15 (LED+) pin16 (LED-)
 - a.1 edge / (white / blue)

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 | | | Crit | eria | | | | | |
|-----|-------------------------|---------|--|--|------------------------------|-----------------------------|---|--|--|--|
| 1 | Black or White spots | 0.10 < | Zone on ≤ 0.10 $\leq D \leq 0.2$ $D \leq 0.3$ | Acceptable Number Disregard 4 | Class Of Defects Minor | Acceptable Level | | | | |
| 4 | (Particle) | D=(Long | 0.3 < D 0 D=(Long + Short)/2 | | | | | | | |
| 4 | | | | not exceed 5/m at outside of A | | affect function i | S | | | |
| | | Z | one | Acceptable | Class Of | 2.5 a't affect function is | | | | |
| | | X(mm) | Y(mm) | Number | Defects | | | | | |
| | | _ | 0.05≧W | Disregard | | | | | | |
| | Scratch, | 4.0≧L | 0.05≧W | 4 | Minor | 2.5 | | | | |
| 2 | Substance s | 3.0≧L | 0.1≧W | 2 | IVIIIIOI | 2.5 | | | | |
| | 3 | | 0.1 <w< td=""><td>0</td><td></td><td></td><td></td></w<> | 0 | | | | | | |
| | | | cts should r | not exceed 5/m | | affect function i | S | | | |



| | | | | | ļļ. | |
|---|---|--|-------------------|-------------------------|-----------------------|----|
| 3 | Air Bubbles (between glass & polarizer) | Zone $D \le 0.2$ $0.2 < D \le 0.5$ $0.5 < D$ Total defects shall not Defect that is located ignored. Bobble is sawn only units. | at outside of A | A and doesn't a | | İs |
| 4 | Displaying Pattern | 1. Incomplete or broken 2. Pinholes Dimension Φ (mm) $\Phi < 0.1$ $0.1 < \Phi \le 0.2$ $0.2 < \Phi \le 0.25$ $0.25 < \Phi$ | | Class Of Defects Minor | Acceptable Level | |
| | | 3. Deformation Dimension Φ (m Φ < 0.15 Φ \leq 0.25 and X \leq Φ > 0.25and X > 1 | Disrega 1/2D 3 | Detects | Acceptable Level 2.5 | |

Other Inspection standard reference Bolymin standard.



11. Reliability

■Content of Reliability Test

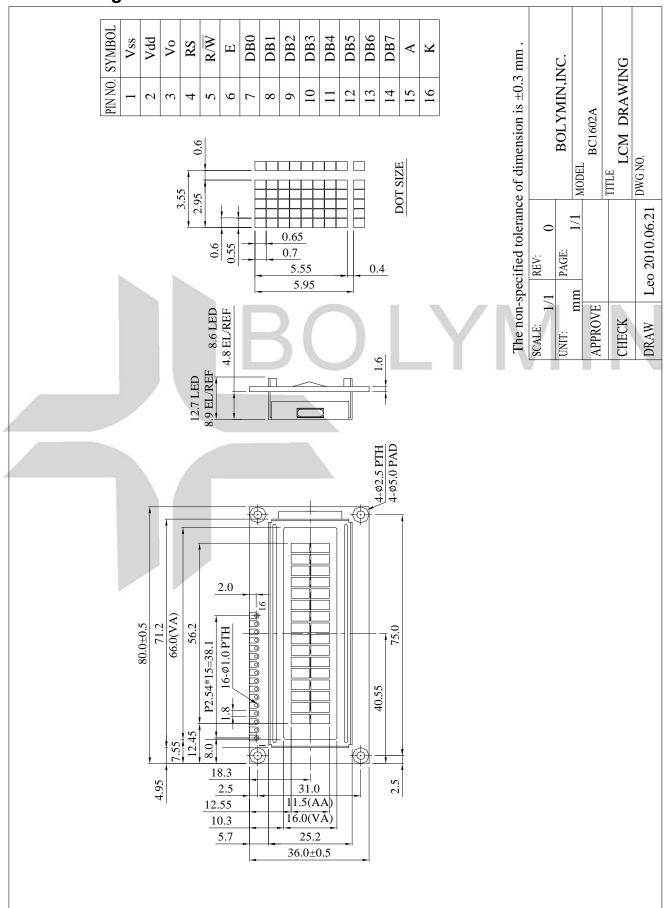
| Envi | ronmental Test | | | |
|------|-----------------------------------|--|--|------------------------|
| No | Test Item | Content of Test | Test Condition | Applicable Standard |
| 1 | High Temperature storage | Endurance test applying the high storage temperature for a long time. | 80℃ 96hrs | |
| 2 | Low Temperature storage | Endurance test applying the high storage temperature for a long time. | -30°C 96hrs | |
| 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 96hrs | |
| 4 | Low Temperature Operation | Endurance test applying the electric stress under low temperature for a long time. | -20°ℂ 96hrs | A |
| 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 cycle30°C 80°C 4 30min 30min 1 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 ST7066U 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)

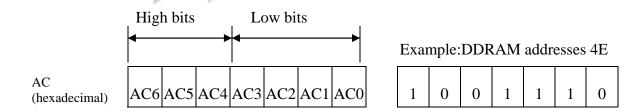
When the busy flag is 1, the controller LSI is in the internal operation mode, and the next instruction will not be accepted. When RS=0 and R/W=1, the busy flag is output to DB7. The next instruction must be written after ensuring that the busy flag is 0.

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 |
|---|---|---|---|---|---|---|---|---|----|----|----|----|----|----|----|
| | | | | | | | | | | | | | | | |

| 00 | 01 | 02 | 03 | 04 | 05 | 06 | 07 | 08 | 09 | 0A | 0B | 0C | 0D | 0E | 0F |
|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|
| 40 | 41 | 42 | 43 | 44 | 45 | 46 | 47 | 48 | 49 | 4A | 4B | 4C | 4D | 4E | 4F |

Example: 2-Line by 16-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 | $ \begin{array}{c ccccccccccccccccccccccccccccccccccc$ | * * * * 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 | Character pattern(1) Cursor pattern |
| 0 0 0 0 * 0 0 1 | 0 0 1 0 1 0 0 1 1 0 0 1 1 1 0 0 1 1 0 1 1 1 0 0 0 | * * * * 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 | Character pattern(2) Cursor pattern |
| | $\begin{bmatrix} 0 & 0 & 0 \\ 0 & 0 & 1 \end{bmatrix}$ | | |
| 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

| 5 * 10 dot character patt | rns | | |
|------------------------------|---|---------------------------------|----------------|
| 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 1 | * * * 0 0 0 0 0 0 0 0 0 | |
| | 0 0 1 0 | * * * * 0 0 | |
| | $\begin{array}{c ccccccccccccccccccccccccccccccccccc$ | * * * * 0 0 0 | |
| 0 0 0 0 * 0 0 0 | 0 0 0 1 0 1 | * * * 0 0 0 | |
| | 0 1 1 0 | * * * 0 | Character |
| | 0 1 1 1 | * * * \ 0 0 0 0 | pattern |
| | 1 0 0 0 | * * * 0 0 0 0 | |
| | | | |
| | 1 0 1 0 | * * * 0 0 0 0 0 | Cursor pattern |
| | | | |
| | | * * * * * * * * | |

: " High "



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

| Upper 4 bii Lower 4 bii | LLLL | LLLH | LLHL | ггин | LHLL | LHLH | LHHL | LH H H | HLLL | HLLH | нінг | нгин | ннгг | ннгн | нннг | нння |
|----------------------------------|------------------|-------------|-------------|---------------|--|------|----------------|----------------|----------------|------------|------------------|-----------|--------------|---------------|-------------------------|----------------|
| LLLL | CG RAM (1) | ·· ! | | I <u>::</u> 1 | | ::: | 4: | ::: - | 1 ::: | E | . :: iı | • | Ţ. | | [| ··[<u>:</u> : |
| LLLH | CG RAM (2) | ::::: | ! | 1. | ıΞ | | -==1 | -::1 | ı . i | 38 | i. | • • • | Ι. | | ••• | 1> |
| LLHL | CG RAM (3) | ןייין ו | TE | | | F | <u> </u> - | l· | ı | Æ | <u>.:</u> . | ••• | *** | : | | <u>"l"</u> |
| LLHH | CG RAM (4) | 7, | : : | | I <u></u> . | 5 | ı <u></u> | :::. | .::: | ::5 | ıı | • | ;;* | -1 [] | 1 | 1. .1 |
| LHLL | CG RAM (5) | | :: | :: - | <u> </u> | T | <u>:::</u> | I <u></u> | | ::: | d :: | • | اـغٍ. | I 1 | • | (;;) |
| LHLH | CG RAM (6) | Ţ | • • · · · | ::::i | Œ | | ı ::: : | II | | : | :E :: | T ::: | ·†· | ا∷ء | 1 1 | .ılı. |
| LHHL | CG RAM (7) | ï | . | : | <u> </u> :::: | ايا | j :: | I I | - ::: | <u>i</u> | ‼ ļ‼ | ا.ا | ٠. <u> </u> | == | EI | II |
| гини | CG RAM (8) | Ţ | :• | ···· | l.::i | Į.,l | -==1 | 1,.,1 | ':: : - | <u></u> 1 | Fi: | ::: | ••• | ,,,, | Ι | 11 |
| HLLL | CG RAM (1) | ľ | ζ. | | | X | ŀ ₁ | ::: | ı | ·i | .;I [.] | : | ·Ę | | ŀ: | |
| нігн | CG RAM (2) | Ï. | 1 | •==• | Τ. | 'T' | i. | ¹::: ! | ı | | i | ::. | l'''' | 11 | .·¹. | ·1:- |
| ніні | CG RAM (3) | ::: | :#: | # | T | | . <u>.:</u> i | :::: | ı i | <u></u> i | : ::; | <u>::</u> | ""] | |] ¹ . | ::" |
| нінн | CG RAM (4) | Ĭ, | | ;; | F. | Ι | ŀ: | ∹ | ïĽ | j.=; | -#i | • | I | ٠١٠ | 1,.: | ··:il |
| HHLL | CG RAM (5) | ::::: | :• | | <u> </u> | ••• | 1 | Ţ | :: | F | | :::- | ! | ::: : | | |
| ннгн | CG RAM (6) | ٠٠,, | | | :- | | ľľi | <u>.</u> ; | i. | :== | | :;ı!: | •• | ı, |] <u> </u> | ••••• |
| нннг | CG RAM (7) | i‼ | | | ·- | ••• | ŀ"ı | •••• | ıäı | | <u>ia:</u> i | ٠.۱ | ı;i | <u></u> ! | ı | |
| нннн | CG RAM (8) | ::I | | | <u> </u> | •••• | ı <u></u> ı | :: <u>'</u> :: | ıë, | € | çı!· | ***** | | ::: :: | ı <u>"</u> ı" | |

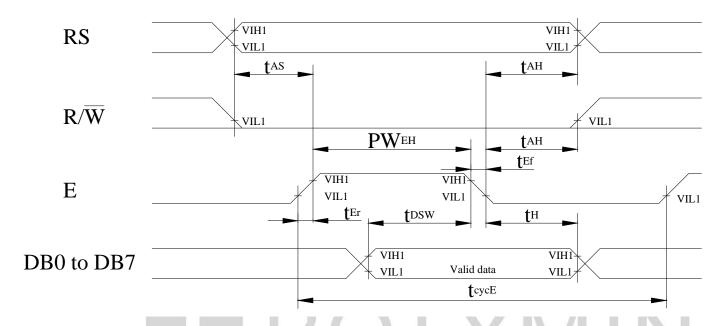


12.2.3 Instruction table

| 12.2.3 111 | . | J (1 O 1 1 | to. | | | | | | | | | | |
|----------------------------------|----------|------------|-----|-----|--------|-------|-----|-----|-----|-----|---|----------------|--|
| Instruction | | 1 | | Ins | tructi | on Co | ode | | | | Description | Execution time | |
| | RS | R/W | DB7 | DB6 | DB5 | DB4 | DB3 | DB2 | DB1 | DB0 | _ | (fosc=270Khz) | |
| Clear Display | 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 | 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 | 1 | I/D | SH | Assign cursor moving direction and enable the shift of entire display. | 37 μ s | |
| Display ON/OFF Control | 0 | 0 | 0 | 0 | 0 | 0 | 1 | D | C | В | Set display (D), cursor (C), and blinking of cursor (B) on/off control bit. | 37 μs | |
| Cursor or Display Shift | 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. | 37 μ s | |
| Function Set | 0 | 0 | 0 | 0 | 1 | DL | N | F | | 1 | Set interface data length (DL:8-bit/4-bit), numbers of display line (N:2-line/1-line)and, display font type (F:5×11dots/5×8 dots) | 37 μ s | |
| Set CGRAM Address | 0 | 0 | 0 | 1 | AC5 | AC4 | AC3 | AC2 | AC1 | AC0 | Set CGRAM address in address counter. | 37 μ s | |
| Set DDRAM Address | 0 | 0 | 1 | AC6 | AC5 | AC4 | AC3 | AC2 | AC1 | AC0 | Set DDRAM address in address counter. | 37 μ s | |
| Read Busy Flag and Address | 0 | 1 | BF | AC6 | AC5 | AC4 | AC3 | AC2 | AC1 | AC0 | Whether during internal operation or not can be known by reading BF. The contents of address counter can also be read. | 0 μ s | |
| Write Data to RAM | 1 | 0 | D7 | D6 | D5 | D4 | D3 | D2 | D1 | D0 | Write data into internal RAM (DDRAM/CGRAM). | 37 μ s | |
| Read Data from RAM | 1 | 1 | D7 | D6 | D5 | D4 | D3 | D2 | D1 | D0 | Read data from internal RAM (DDRAM/CGRAM). | 37 μ s | |



12.2.4 Timing characteristics12.2.4.1 Write Operation

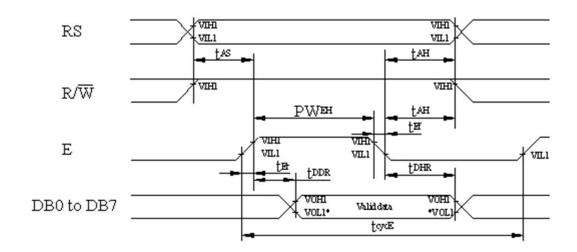


 $Ta=25^{\circ}C$, $Vdd=5.0\pm0.5V$

| Item | Symbol | Min | Тур | 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

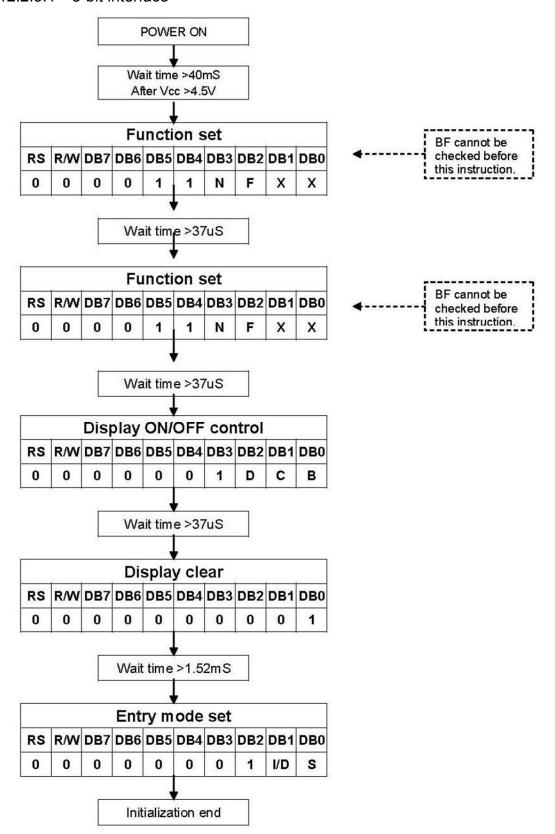


Ta=25°C.Vdd=5.0±0.5V

| Item | Symbol | Min | Тур | Max | Unit |
|------------------------------------|-------------------|------|-----|-----|------|
| Enable cycle time | t _{cycE} | 1200 | - | ı | 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





12.2.5.2 4-bit interface

