

SPECIFICATION

| | |
|-----------|----------------|
| MODULE NO | NC1602B-serise |
| VERSION | VER.0 |
| CUSTOMER | |
| APPROVE | |

| | | |
|---------|----------|------------|
| Sale by | Check by | Prepare by |
| | | |

科創光電股份有限公司

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1. Numbering system

N C 1602 B - G H Y - RS
 1 2 3 4 5 6 7 8 9

1. Brand Name

| | |
|---|-------------------------|
| N | NEWTEC Display Co., LTD |
|---|-------------------------|

2. Display Type

| | |
|---|---------------|
| T | TAB |
| B | Graphic |
| C | Character |
| O | COG |
| P | PLED |
| R | Color-STN |
| S | Seven-Segment |
| F | TFT |

3. Number of Pixels

| | |
|------------------|-----------------------------|
| Character Module | Characters per line × Lines |
| Graphic Module | Row Dots × Column Dots |

4. Series number

| | |
|-----|---------------|
| A~Z | Series Number |
|-----|---------------|

5. LCD Mode:

| | TN | STN | | FSTN | Color-STN | TFT |
|----------|----|-----|--------------|------|-----------|--------------|
| Positive | T | G | Gary | F | R | T (Black) |
| | | Y | Yellow/Green | | | |
| Negative | N | B | Blue | M | | |

6. LCD Polarize

| | Normal Temperature | | Wide Temperature | |
|---------------|--------------------|-------|------------------|-------|
| | 6:00 | 12:00 | 6:00 | 12:00 |
| Reflective | A | D | G | J |
| Transflective | B | E | H | K |
| Transmissive | C | F | I | L |

7. Backlight

| | | |
|------|---|--------------------|
| None | N | None |
| EL | H | White |
| | U | Blue Green |
| LED | A | Amber |
| | B | Blue |
| | E | Yellow/Green, edge |
| | G | Green |
| | R | Red |
| | W | White |
| | Y | Yellow/Green |
| CCFL | C | White |

8. IC font (Character)

| | |
|------------------|-----------------|
| Cyrillic/English | TS |
| Chinese/English | C(BIG 5), S(GB) |
| Japanese/English | PN,PS,PM |
| European/English | RN,RS,RK |

9. Special code

| | |
|---|---|
| A | Anti-glare |
| H | Touch panel |
| M | Negative voltage output and temperature compensation on board |
| N | With negative voltage output on board |
| X | Without negative voltage output on board |

10. Others

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

2. Precaution in use of LCD Module

- (1) Avoid applying excessive shocks to the module or making any alterations or modifications to it.
- (2) Don't make extra holes on the printed circuit board, modify its shape or change the components of LCD module.
- (3) Don't disassemble the LCM.
- (4) Don't operate it above the absolute maximum rating.
- (5) Don't drop, bend or twist LCM.
- (6) Soldering: only to the I/O terminals.
- (7) Storage: please storage in anti-static electricity container and clean environment.
- (8) Don't touch the elastomer connector, especially insert a backlight panel (EL or CCFL)

3. General Specification

3.1 Mechanical Dimension

| Item | Dimension | Unit |
|------------------------------|---|------|
| Number of Characters | 16 characters x 2 Lines | - |
| Module dimension (L x W x H) | 80.0 x 36.0 x 9.4 (Max)-EL B/L or NO B/L 80.0 x 36.0 x 13.2 (Max)- LED B/L | mm |
| View area | 66.0 x 16.0 | mm |
| Active area | 56.21 x 11.5 | mm |
| Dot size | 0.56 x 0.66 | mm |
| Dot pitch | 0.6x 0.7 | mm |
| Character size (L x W) | 2.96 x 5.46 | mm |
| Character pitch (L x W) | 3.55 x 5.94 | mm |

3.2 Controller IC: KS0066 (or Equivalent) controller

3.3 Temperature Range

| | Normal temperature | Wide temperature |
|-----------------------|--------------------|------------------|
| Operation temperature | 0 ~ +50 | -20 ~ +70 |
| Storage temperature | -10 ~ + 60 | -30 ~ + 80 |

4. Absolute Maximum Ratings

4.1 Electrical Absolute Maximum Ratings

(V_{SS}=0V, T_a=25 °C)

| Item | Symbol | Min | Max | Unit |
|-----------------------------|-----------------------------------|-----------------|-----------------|------|
| Supply Voltage (Logic) | V _{DD} - V _{SS} | -0.3 | 7.0 | V |
| Supply Voltage (LCD driver) | V _{DD} -V _O | -0.3 | 13 | V |
| Input Voltage | V _I | V _{SS} | V _{DD} | V |
| Normal Type | T _{OP} | 0 | +50 | |
| | T _{STG} | -10 | +60 | |
| Wide Temperature Type | Top | -20 | +70 | |
| | Tstg | -30 | +80 | |

4.2 Environmental Absolute Maximum Ratings

| Item | Operating | | Storage | | Comment |
|-----------|-----------|----------------------|---------|----------------------|----------------------|
| | (Min.) | (Max.) | (Min.) | (Max.) | |
| Humidity | Note(2) | | Note(2) | | Without condensation |
| Vibration | -- | 4.9M/S ² | -- | 19.6M/S ² | XYZ Direction |
| Shock | -- | 29.4M/S ² | -- | 490M/S ² | XYZ Direction |

Note (1) T_a = 0 : 50Hr Max.

Note (2) T_a = 40 : 90% RH MAX

T_a > 40 : Absolute humidity must be lower than the humidity of 90% at 40 °C.

5. Electrical Characteristics

| Item | Symbol | Condition | Min. | Typ. | Max. | Unit |
|--|-----------------|-----------|------|------|------|------|
| Supply Voltage For Logic | Vdd-Vss | - | 2.8 | 5.0 | 5.5 | V |
| Supply Voltage For LCD *Wide Temp、 Type | Vdd-Vo | - | | | 4.5 | -20 |
| | | | | 4.0 | | 25 |
| | | | 3.5 | | | 70 |
| Input High Vol. | V _{IH} | - | 2.2 | - | Vdd | V |
| Input Low Vol. | V _{IL} | - | - | - | 0.6 | V |
| Output High Vol. | V _{OH} | - | 2.4 | - | - | V |
| Output Low Vol. | V _{OL} | - | - | - | 0.4 | V |
| Supply Current(Logic) | I _{dd} | Vdd=5V | - | 1.2 | - | mA |

6. Optical Characteristics

- STN

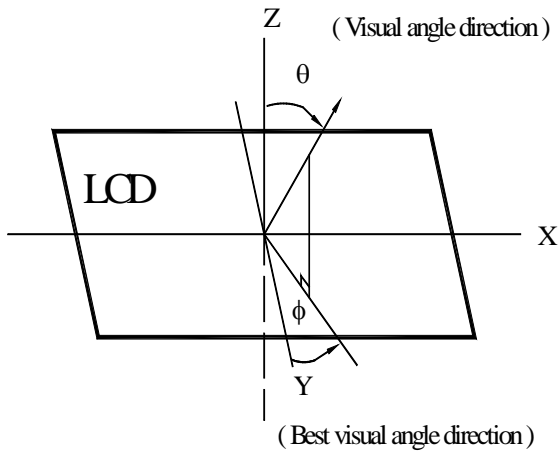
| Item | Symbol | Condition | Min. | Typ. | Max. | Unit |
|---------------------|--------|-----------|------|------|------|------|
| View Angle | (V) | CR 2 | 10 | | 45 | deg |
| | (H) | CR 2 | -30 | | 30 | deg |
| Contrast Ratio | CR | - | | 3 | | - |
| Response Time 25 | T rise | - | | 100 | 150 | ms |
| | T fall | - | | 150 | 200 | Ms |

- FSTN

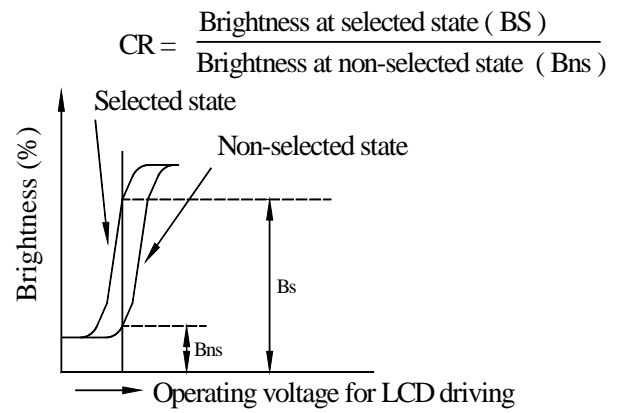
| Item | Symbol | Condition | Min. | Typ. | Max. | Unit |
|---------------------|--------|-----------|------|------|------|------|
| View Angle | (V) | CR 2 | 10 | | 50 | deg |
| | (H) | CR 2 | -45 | | 45 | deg |
| Contrast Ratio | CR | - | | 5 | | - |
| Response Time 25 | T rise | - | | 100 | 150 | ms |
| | T fall | - | | 150 | 200 | ms |

6.1 Definitions

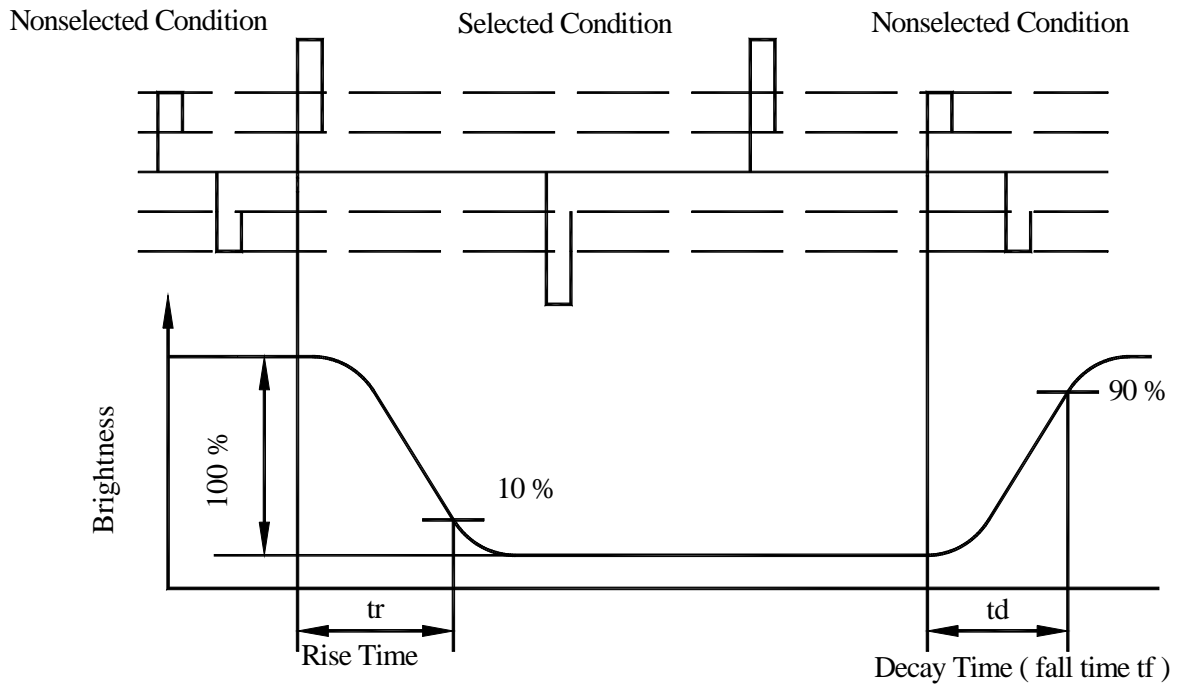
View Angles



Contrast Ratio



Response Time



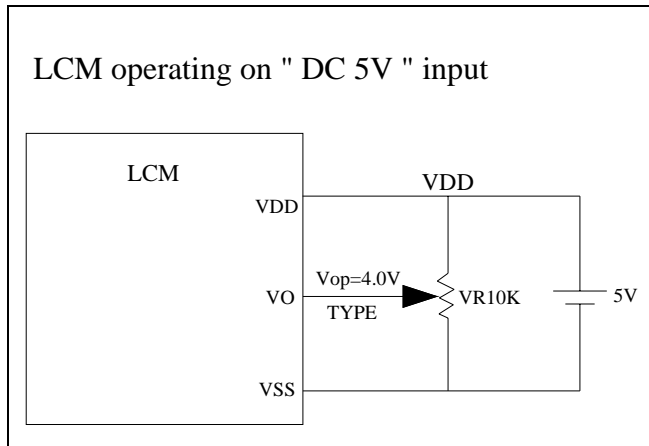
7. Interface Pin Function

| Pin No. | Symbol | Level | Description |
|---------|--------|------------|---|
| 1 | Vss | 0V | Supply Voltage for logic Ground |
| 2 | Vdd | 5.0V | Supply Voltage for logic and LED backlight |
| 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/Vee | | Power supply for backlight V+/Negative Voltage Output |
| 16 | K | | Power supply for backlight V- |

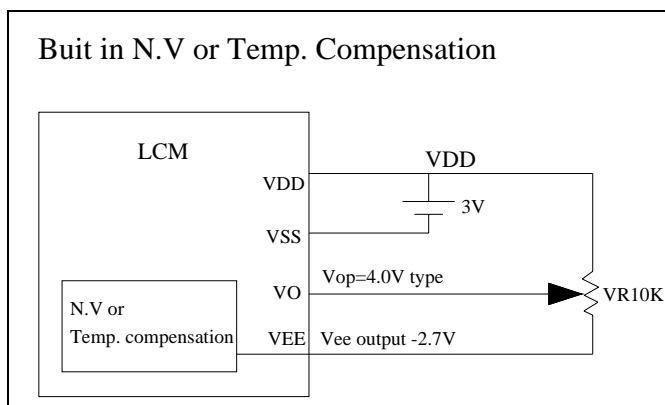
8. Power Supply for LCD Module and LCD Operating Voltage

Adjustment

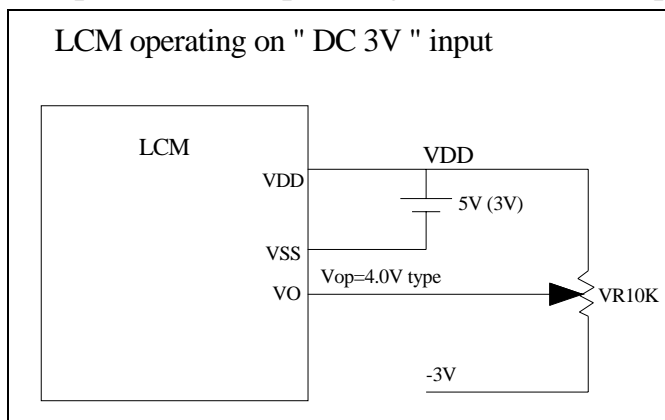
*Stander Type



* (Option) LCM operating on " DC 3V " input , with Built in negative voltage



* (Option) LCM operating on " DC 3V " input , with external negative voltage



9. Backlight Information

9.1 Specification

- LED array yellow-green

| Parameter | Symbol | Min | Typical | Max | Unit | Test Condition |
|--------------------|------------------|-----|---------|-----|-------------------|-------------------------|
| Supply Current | I _{LED} | - | 100 | - | mA | V _{LED} =4.2V |
| Supply Voltage | V | 4.0 | 4.2 | 4.3 | V | - |
| Reverse Voltage | V _R | - | - | 8 | V | - |
| Luminous Intensity | I _V | 100 | - | - | cd/m ² | I _{LED} =100mA |
| Wave Length | λ | - | 575 | - | nm | I _{LED} =100mA |
| Life Time | - | - | 100,000 | - | Hr. | V 4.3V |
| Color | Yellow green | | | | | |

- LED edge yellow-green

| Parameter | Symbol | Min | Typical | Max | Unit | Test Condition |
|--------------------|------------------|-----|---------|-----|-------------------|------------------------|
| Supply Current | I _{LED} | - | 20 | - | mA | V _{LED} =4.2V |
| Supply Voltage | V | 4.0 | 4.2 | 4.3 | V | - |
| Reverse Voltage | V _R | - | - | 8 | V | - |
| Luminous Intensity | I _V | 6 | - | - | cd/m ² | I _{LED} =20mA |
| Wave Length | λ | - | 575 | - | nm | I _{LED} =20mA |
| Life Time | - | - | 100,000 | - | Hr. | V 4.3V |
| Color | Yellow green | | | | | |

- LED edge white

| Parameter | Symbol | Min | Typical | Max | Unit | Test Condition |
|----------------|------------------|-----|---------|-----|------|------------------------|
| Supply Current | I _{LED} | - | 20 | - | mA | V _{LED} =3.2V |

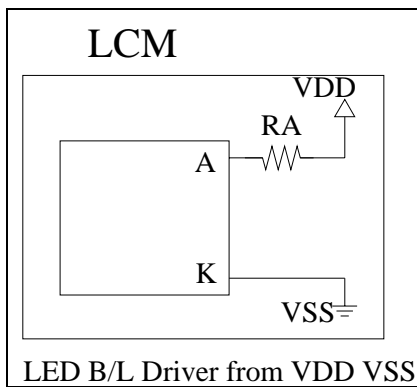
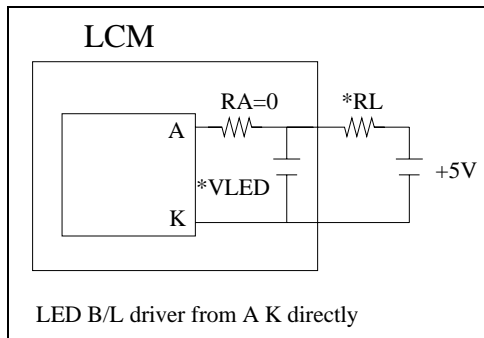
| | | | | | | |
|--------------------|-------|----|--------|-----|-------------------|-----------|
| Supply Voltage | V | | 3.2 | 3.4 | V | - |
| Reverse Voltage | VR | - | - | 5 | V | - |
| Luminous Intensity | IV | 80 | - | - | cd/m ² | ILED=20mA |
| Chromaticity | X | - | 0.30 | - | | ILED=20mA |
| | Y | | 0.31 | | | |
| Life Time | - | - | 70,000 | - | Hr. | V 3.2V |
| Color | white | | | | | |

● EL white / blue

| Parameter | Symbol | Min | Typ | Max | Unit | Test Condition |
|--------------------------|--------------------|-----|---------------|-----|------|------------------|
| Voltage | Vrms | -- | 110 (AC) | | -- | |
| Frequency | HZ | -- | 400 | | -- | |
| Brightness* | cd/m ² | 48 | 60 | | -- | 110Vrms 400Hz |
| CIE Chromaticity Diagram | X | -- | 0.3019(white) | | -- | |
| | | | 0.330 (blue) | | | |
| | Y | -- | 0.3929(white) | | -- | |
| | | | 0.365 (blue) | | | |
| Current Dissipation | mA/cm ² | -- | 3.63 | | -- | |
| Power Dissipation | mW/cm ² | -- | 71.71 | | -- | |
| Color | Blue , white | | | | | |

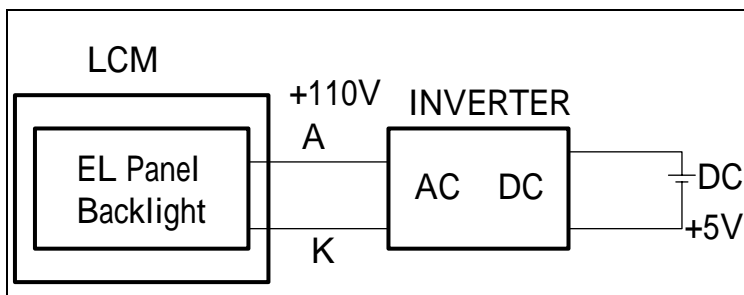
9.2 Backlight driving methods

a. LED B/L drive methods



- * 1.array (yellow green) LED B/L driver : $V_{LED}=4.2V$ $R_L=8\Omega$
- 2. edge (yellow green) LED B/L driver : $V_{LED}=4.2V$ $R_L=40\Omega$
- 3. edge (white/blue) LED B/L driver : $V_{LED}=3.2V$ $R_L=90\Omega$

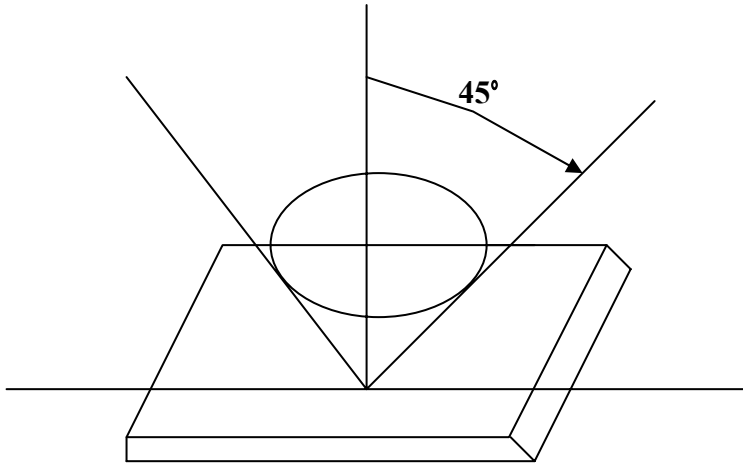
b. E/L B/L driven from A.K cable directly



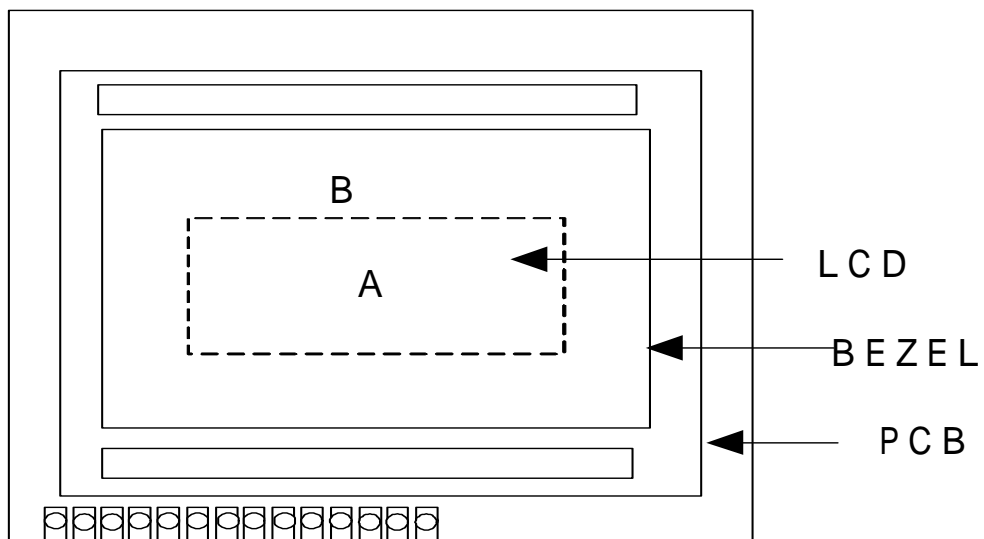
10. Quality Assurance

10.1 Inspection conditions

The LCD shall be inspected under 40W white fluorescent light.



Definition of applicable Zones

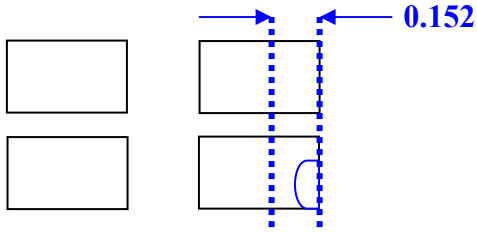
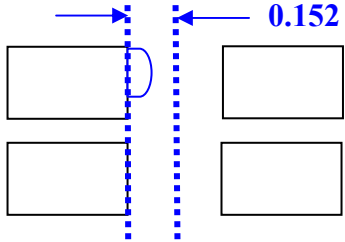
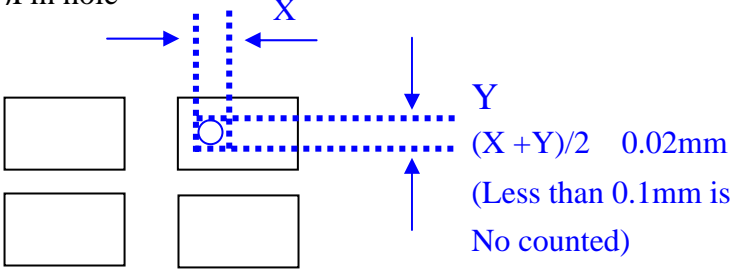
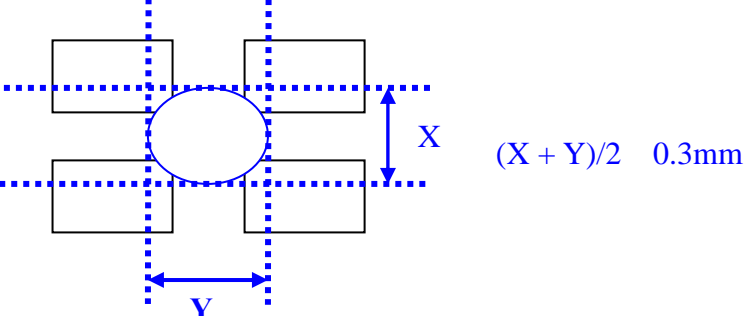


A : Display Area

B : Non-Display Area

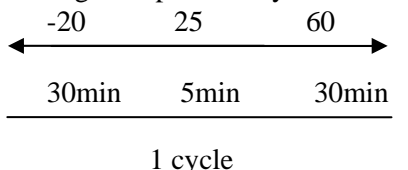
10.2 Inspection Parameters

| NO. | Parameter | Criteria | | | | | | | | | | | | | | | | | | | | | |
|---------------------|---|---|---------------------|-------------------|------------------|------------------|------------------|---|---|----------------|---|---|-------|-----|------------------|---|---|------------------|---|---|--------------|---|---|
| 1 | Black or White spots | <table border="1" style="width: 100%; border-collapse: collapse;"> <thead> <tr> <th rowspan="2" style="width: 30%;">Zone Dimension</th> <th colspan="2" style="width: 20%;">Acceptable Number</th> <th rowspan="2" style="width: 15%;">Class Of Defects</th> <th rowspan="2" style="width: 35%;">Acceptable Level</th> </tr> <tr> <th style="width: 10%;">A</th> <th style="width: 10%;">B</th> </tr> </thead> <tbody> <tr> <td>D < 0.15</td> <td style="text-align: center;">*</td> <td style="text-align: center;">*</td> <td rowspan="4" style="text-align: center;">Minor</td> <td rowspan="4" style="text-align: center;">2.5</td> </tr> <tr> <td>0.15 D 0.2</td> <td style="text-align: center;">4</td> <td style="text-align: center;">4</td> </tr> <tr> <td>0.2 D 0.25</td> <td style="text-align: center;">2</td> <td style="text-align: center;">2</td> </tr> <tr> <td>D 0.3</td> <td style="text-align: center;">0</td> <td style="text-align: center;">1</td> </tr> </tbody> </table> <p>D=(Long + Short)/2 *: Disregard</p> | Zone Dimension | Acceptable Number | | Class Of Defects | Acceptable Level | A | B | D < 0.15 | * | * | Minor | 2.5 | 0.15 D 0.2 | 4 | 4 | 0.2 D 0.25 | 2 | 2 | D 0.3 | 0 | 1 |
| Zone Dimension | Acceptable Number | | | Class Of Defects | Acceptable Level | | | | | | | | | | | | | | | | | | |
| | A | B | | | | | | | | | | | | | | | | | | | | | |
| D < 0.15 | * | * | Minor | 2.5 | | | | | | | | | | | | | | | | | | | |
| 0.15 D 0.2 | 4 | 4 | | | | | | | | | | | | | | | | | | | | | |
| 0.2 D 0.25 | 2 | 2 | | | | | | | | | | | | | | | | | | | | | |
| D 0.3 | 0 | 1 | | | | | | | | | | | | | | | | | | | | | |
| 2 | Scratch, Substances | <table border="1" style="width: 100%; border-collapse: collapse;"> <thead> <tr> <th rowspan="2" style="width: 30%;">Zone X(mm)/Y(mm)</th> <th colspan="2" style="width: 20%;">Acceptable Number</th> <th rowspan="2" style="width: 15%;">Class Of Defects</th> <th rowspan="2" style="width: 35%;">Acceptable Level</th> </tr> <tr> <th style="width: 10%;">A</th> <th style="width: 10%;">B</th> </tr> </thead> <tbody> <tr> <td style="text-align: center;">* 0.04 W</td> <td style="text-align: center;">*</td> <td style="text-align: center;">*</td> <td rowspan="4" style="text-align: center;">Minor</td> <td rowspan="4" style="text-align: center;">2.5</td> </tr> <tr> <td style="text-align: center;">3.0 L W</td> <td style="text-align: center;">4</td> <td style="text-align: center;">4</td> </tr> <tr> <td style="text-align: center;">2.0 L W</td> <td style="text-align: center;">2</td> <td style="text-align: center;">3</td> </tr> <tr> <td style="text-align: center;">- 0.1 < W</td> <td style="text-align: center;">0</td> <td style="text-align: center;">1</td> </tr> </tbody> </table> <p>X: Length Y: Width *: Disregard Total defects should not exceed 4/module</p> | Zone X(mm)/Y(mm) | Acceptable Number | | Class Of Defects | Acceptable Level | A | B | * 0.04 W | * | * | Minor | 2.5 | 3.0 L W | 4 | 4 | 2.0 L W | 2 | 3 | - 0.1 < W | 0 | 1 |
| Zone X(mm)/Y(mm) | Acceptable Number | | | Class Of Defects | Acceptable Level | | | | | | | | | | | | | | | | | | |
| | A | B | | | | | | | | | | | | | | | | | | | | | |
| * 0.04 W | * | * | Minor | 2.5 | | | | | | | | | | | | | | | | | | | |
| 3.0 L W | 4 | 4 | | | | | | | | | | | | | | | | | | | | | |
| 2.0 L W | 2 | 3 | | | | | | | | | | | | | | | | | | | | | |
| - 0.1 < W | 0 | 1 | | | | | | | | | | | | | | | | | | | | | |
| 3 | Air Bubbles (between glass & polarizer) | <table border="1" style="width: 100%; border-collapse: collapse;"> <thead> <tr> <th rowspan="2" style="width: 30%;">Zone Dimension</th> <th colspan="2" style="width: 20%;">Acceptable Number</th> <th rowspan="2" style="width: 15%;">Class Of Defects</th> <th rowspan="2" style="width: 35%;">Acceptable Level</th> </tr> <tr> <th style="width: 10%;">A</th> <th style="width: 10%;">B</th> </tr> </thead> <tbody> <tr> <td>D 0.15</td> <td style="text-align: center;">*</td> <td style="text-align: center;">*</td> <td rowspan="3" style="text-align: center;">Minor</td> <td rowspan="3" style="text-align: center;">2.5</td> </tr> <tr> <td>0.15 < D 0.25</td> <td style="text-align: center;">2</td> <td style="text-align: center;">*</td> </tr> <tr> <td>0.25 < D</td> <td style="text-align: center;">0</td> <td style="text-align: center;">1</td> </tr> </tbody> </table> <p>*: Disregard Total defects shall not excess 3/module.</p> | Zone Dimension | Acceptable Number | | Class Of Defects | Acceptable Level | A | B | D 0.15 | * | * | Minor | 2.5 | 0.15 < D 0.25 | 2 | * | 0.25 < D | 0 | 1 | | | |
| Zone Dimension | Acceptable Number | | | Class Of Defects | Acceptable Level | | | | | | | | | | | | | | | | | | |
| | A | B | | | | | | | | | | | | | | | | | | | | | |
| D 0.15 | * | * | Minor | 2.5 | | | | | | | | | | | | | | | | | | | |
| 0.15 < D 0.25 | 2 | * | | | | | | | | | | | | | | | | | | | | | |
| 0.25 < D | 0 | 1 | | | | | | | | | | | | | | | | | | | | | |

| | | |
|-----------|-------------------|---|
| <p>4.</p> | <p>Uniformity</p> | <p>(1) Pixel shape (with Dent)</p>  <p>(2) Pixel shape (with Projection)</p>  <p>(3) Pin hole</p>  <p>(4) Deformation</p>  <p>Total acceptable number: 1/pixel ;.5/cell</p> |
|-----------|-------------------|---|

11. Reliability

11.1 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. | 60 / 200hrs | — |
| 2 | Low Temperature storage | Endurance test applying the high storage temperature for a long time. | -20 200hrs | — |
| 3 | High Temperature Operation | Endurance test applying the electric stress (Voltage & Current) and the thermal stress to the element for a long time. | 50 200hrs | — |
| 4 | Low Temperature Operation | Endurance test applying the electric stress under low temperature for a long time. | 0 200hrs | — |
| 5 | High Temperature/ Humidity Storage | Endurance test applying the high temperature and high humidity storage for a long time. | 60 ,90%RH 96hrs | — |
| 6 | High Temperature/ Humidity Operation | Endurance test applying the electric stress (Voltage & Current) and temperature / humidity stress to the element for a long time. | 40 ,90%RH 96hrs | — |
| 7 | Temperature Cycle | Endurance test applying the low and high temperature cycle.  | -20 /60 10 cycles | — |
| Mechanical Test | | | | |
| 8 | Vibration test | Endurance test applying the vibration during transportation and using. | 10~22Hz 1.5mmp-p 22~500Hz 1.5G Total 0.5hrs | — |
| 9 | Shock test | Constructional and mechanical endurance test applying the shock during transportation. | 50G Half sign wave 11 msdc 3 times of each direction | — |
| 10 | Atmospheric pressure test | Endurance test applying the atmospheric pressure during transportation by air. | 115mbar 40hrs | — |
| Others | | | | |
| 11 | Static electricity test | Endurance test applying the electric stress to the terminal. | VS=800V,RS=1.5k CS=100pF 1 time | — |

***Supply voltage for logic system=5V. Supply voltage for LCD system =Operating voltage at 25

12. Controller data

12.1 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)

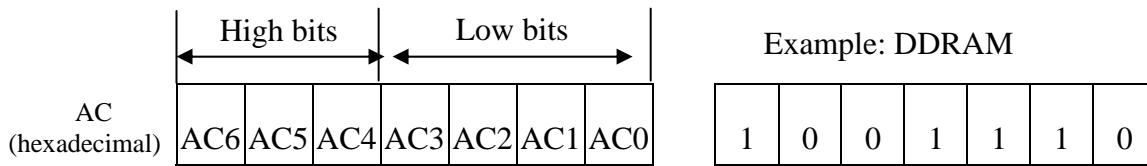
When the busy flag is 1, the controller LSI is in the internal operation mode and the next instruction will not be accepted. When RS=0 and R/W=1, the busy flag is output to DB7. The next instruction must be written after ensuring that the busy flag is 0.

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 | | | | | | | | | 0F |
| 40 | 41 | 42 | 43 | 44 | 45 | 46 | | | | | | | | | 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.

12.2 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)

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 | | |
| High | | | | Low | | | | High | | | Low | | | High | | | | Low | | | | | | | |
| 0 0 0 0 * 0 0 0 | | | | | | | | 0 0 0 | | | | | | 0 0 0 | * * * | | | | | | | | Character pattern(1) | | |
| | | | | | | | | | | | | | | 0 0 1 | * * * | | | | | | | | 0 0 0 | | |
| | | | | | | | | | | | | | | 0 1 0 | * * * | | | | | | | | 0 0 0 | | |
| | | | | | | | | | | | | | | 0 1 1 | * * * | | | | | | | | 0 | | |
| | | | | | | | | | | | | | | 1 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 | | |
| | | | | | | | | | | | | | | 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 1 | * * * | 0 0 | 0 0 | Character pattern(2) | | | | | | | |
| | | | | | | | | | | | | | | 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 * 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 | | | | |
| High | | | | | Low | | | | | High | | | | | Low | | | | | High | | | | | Low | | | | | | | | | | | | |
| 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 1 0 | * * * | | | | | | | | | | | 0 | 0 0 | | | | |
| | | | | | | | | | | | | | | | | | | | | 0 0 1 1 | * * * | | | | | | | | | | | 0 0 | | | | | |
| | | | | | | | | | | | | | | | | | | | | 0 1 0 0 | * * * | | | | | | | | | | | 0 0 0 | | | | | |
| | | | | | | | | | | | | | | | | | | | | 0 1 0 1 | * * * | | | | | | | | | | | 0 0 0 | | | | | |
| | | | | | | | | | | | | | | | | | | | | 0 1 1 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 "

12.3 C.G ROM table (table 2)

Code RS RN RK: 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) | | | | | | | | | | | | | | | |
| LLLH | CG RAM (2) | | | | | | | | | | | | | | | |
| LLHL | CG RAM (3) | | | | | | | | | | | | | | | |
| LLHH | CG RAM (4) | | | | | | | | | | | | | | | |
| LHLL | CG RAM (5) | | | | | | | | | | | | | | | |
| LHLH | CG RAM (6) | | | | | | | | | | | | | | | |
| LHHL | CG RAM (7) | | | | | | | | | | | | | | | |
| LHHH | CG RAM (8) | | | | | | | | | | | | | | | |
| HLLL | CG RAM (1) | | | | | | | | | | | | | | | |
| HLLH | CG RAM (2) | | | | | | | | | | | | | | | |
| HLHL | CG RAM (3) | | | | | | | | | | | | | | | |
| HLHH | CG RAM (4) | | | | | | | | | | | | | | | |
| HHLL | CG RAM (5) | | | | | | | | | | | | | | | |
| HHLH | CG RAM (6) | | | | | | | | | | | | | | | |
| HHHL | CG RAM (7) | | | | | | | | | | | | | | | |
| HHHH | CG RAM (8) | | | | | | | | | | | | | | | |

Code PS PN PM: English –Japanese 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) | | | 0 | 1 | 2 | 3 | 4 | | | | 5 | 6 | 7 | 8 | 9 |
| LLLH | (2) | ! | " | # | \$ | % | & | ' | | | (|) | * | + | , | . |
| LLHL | (3) | : | ; | < | = | > | ?@ | [| | | ^ | _ | ~ | ! | " | # |
| LLHH | (4) | ! | " | # | \$ | % | & | ' | | | (|) | * | + | , | . |
| LHLL | (5) | : | ; | < | = | > | ?@ | [| | | ^ | _ | ~ | ! | " | # |
| LHLH | (6) | : | ; | < | = | > | ?@ | [| | | ^ | _ | ~ | ! | " | # |
| LHHL | (7) | : | ; | < | = | > | ?@ | [| | | ^ | _ | ~ | ! | " | # |
| LHHH | (8) | : | ; | < | = | > | ?@ | [| | | ^ | _ | ~ | ! | " | # |
| HLLL | (1) | : | ; | < | = | > | ?@ | [| | | ^ | _ | ~ | ! | " | # |
| HLLH | (2) | : | ; | < | = | > | ?@ | [| | | ^ | _ | ~ | ! | " | # |
| HLHL | (3) | : | ; | < | = | > | ?@ | [| | | ^ | _ | ~ | ! | " | # |
| HLHH | (4) | : | ; | < | = | > | ?@ | [| | | ^ | _ | ~ | ! | " | # |
| HHLL | (5) | : | ; | < | = | > | ?@ | [| | | ^ | _ | ~ | ! | " | # |
| HHLH | (6) | : | ; | < | = | > | ?@ | [| | | ^ | _ | ~ | ! | " | # |
| HHHL | (7) | : | ; | < | = | > | ?@ | [| | | ^ | _ | ~ | ! | " | # |
| HHHH | (8) | : | ; | < | = | > | ?@ | [| | | ^ | _ | ~ | ! | " | # |

Code TS: English –Cyrillic 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) | | | G | A | P | ' | P | | | E | W | . | W | | |
| LLLH | CG RAM (2) | | ! | 1 | A | O | a | a | | | r | W | , | U | | |
| LLHL | CG RAM (3) | | " | 2 | B | B | b | r | | | e | e | e | u | | |
| LLHH | CG RAM (4) | | * | 3 | C | S | c | s | | | W | W | W | a | | |
| LHLL | CG RAM (5) | | * | 4 | D | T | t | t | | | B | r | Y | o | | |
| LHLH | CG RAM (6) | | * | 5 | E | L | e | u | | | W | o | X | U | | |
| LHHL | CG RAM (7) | | * | 6 | F | U | f | u | | | C | W | Y | W | | |
| LHHH | CG RAM (8) | | * | 7 | G | U | g | u | | | J | a | I | ' | | |
| HLLL | CG RAM (1) | | ^ | 8 | H | X | h | x | | | r | W | U | | | |
| HLLH | CG RAM (2) | | ^ | 9 | I | Y | i | y | | | V | W | T | ' | | |
| HLHL | CG RAM (3) | | * | 0 | J | Z | j | z | | | O | K | U | e | | |
| HLHH | CG RAM (4) | | * | 1 | K | C | k | c | | | Y | W | T | W | | |
| HHLL | CG RAM (5) | | ^ | 2 | L | X | l | x | | | U | W | W | U | | |
| HHLH | CG RAM (6) | | ^ | 3 | M | N | m | n | | | b | W | C | W | | |
| HHHL | CG RAM (7) | | ^ | 4 | N | W | n | w | | | U | W | S | Y | | |
| HHHH | CG RAM (8) | | ^ | 5 | O | e | o | e | | | O | T | E | . | O | |

Code MS MM: English –European Font

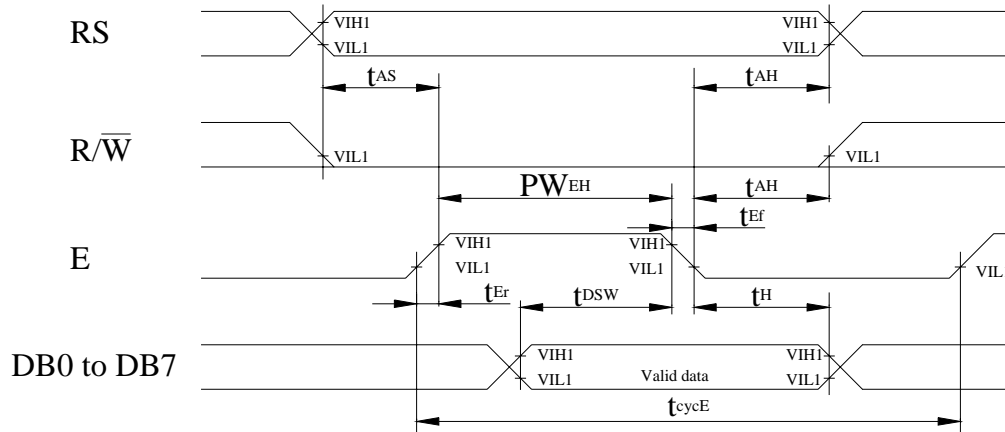
| Upper 4 bit Lower 4 bit | LLLL | LLLH | LLHL | LLHH | LHLL | LHLH | LHHL | LHHH | HLLL | HLLH | HLHL | HLHH | HHLL | HHLH | HHHL | HHHH |
|----------------------------------|------------------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|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

12.4 Instruction table

| Instruction | Instruction Code | | | | | | | | | | Description | Execution time (fosc=270Khz) | |
|----------------------------|------------------|-----|-----|-----|-----|-----|-----|-----|-----|-----|---|--|--------|
| | RS | R/W | DB7 | DB6 | DB5 | DB4 | DB3 | DB2 | DB1 | DB0 | | | |
| Clear Display | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | Write "00H" to DDRAM and set DDRAM address to "00H" from AC | 1.53ms | |
| 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. | 1.53ms |
| 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. | 39 μ s |
| 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. | 39 μ s |
| 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. | 39 μ s |
| Function Set | 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) | 39 μ s |
| Set CGRAM Address | 0 | 0 | 0 | 1 | AC5 | AC4 | AC3 | AC2 | AC1 | AC0 | | Set CGRAM address in address counter. | 39 μ s |
| Set DDRAM Address | 0 | 0 | 1 | AC6 | AC5 | AC4 | AC3 | AC2 | AC1 | AC0 | | Set DDRAM address in address counter. | 39 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). | 43 μ s |
| Read Data from RAM | 1 | 1 | D7 | D6 | D5 | D4 | D3 | D2 | D1 | D0 | | Read data from internal RAM (DDRAM/CGRAM). | 43 μ s |

12.5 Timing characteristics

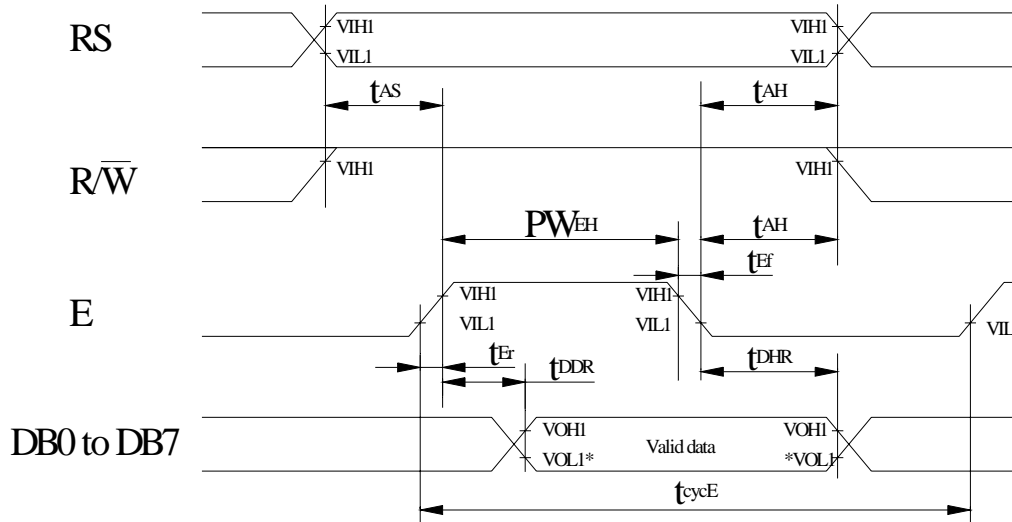
Write Operation



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

| Item | Symbol | Min | Typ | Max | Unit |
|------------------------------------|------------------|-----|-----|-----|------|
| Enable cycle time | t_{cycE} | 500 | - | - | ns |
| Enable pulse width (high level) | PW_{EH} | 230 | - | - | ns |
| Enable rise/fall time | t_{Er}, t_{Ef} | - | - | 20 | ns |
| Address set-up time (RS, R/W to E) | t_{AS} | 40 | - | - | ns |
| Address hold time | t_{AH} | 10 | - | - | ns |
| Data set-up time | t_{Dsw} | 80 | - | - | ns |
| Data hold time | t_H | 10 | - | - | ns |

Read Operation



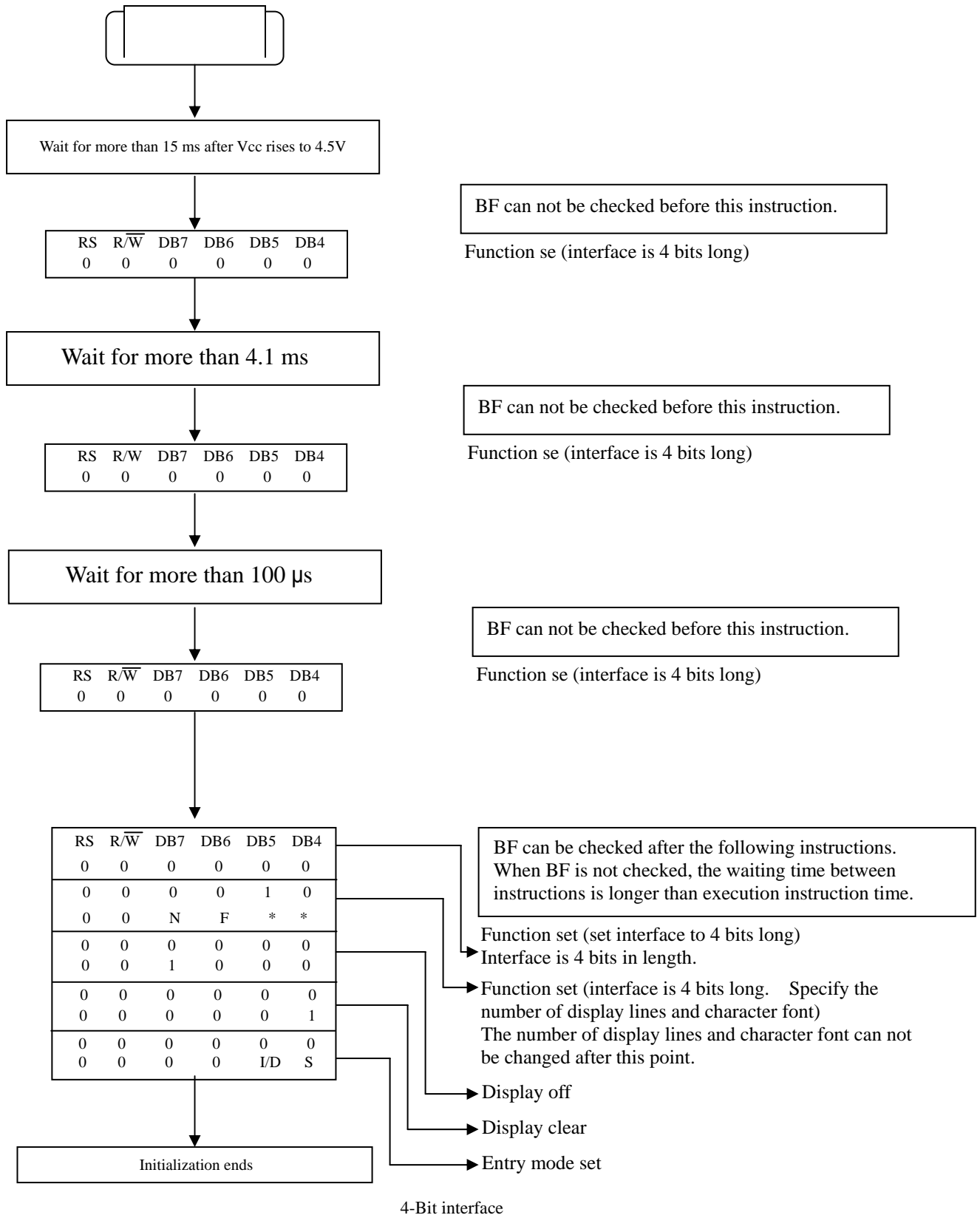
NOTE: *VOL1 is assumed to be 0.8V at 2 MHz operation.

$T_a=25$, $V_{dd}=5.0\pm 0.5V$

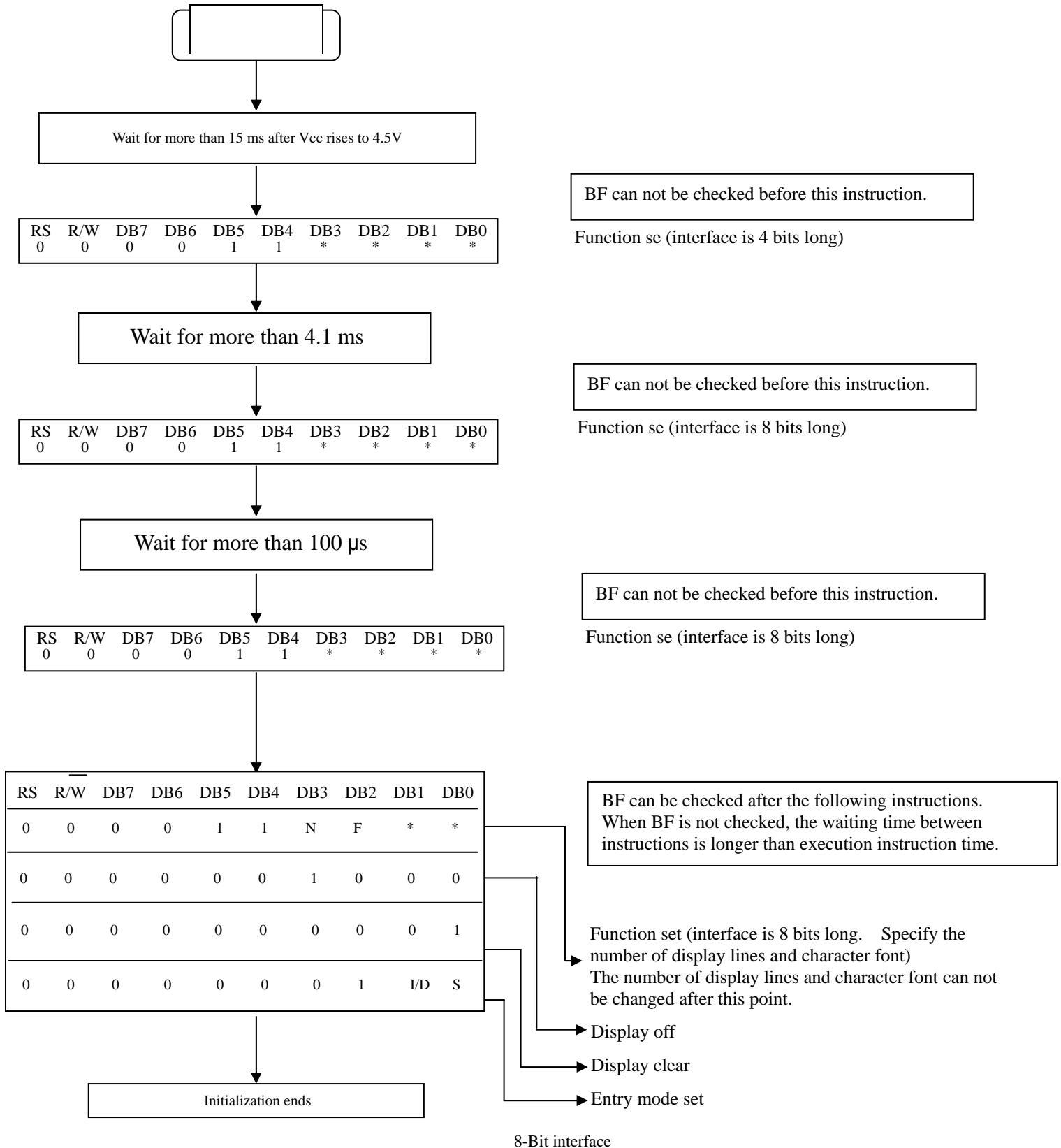
| Item | Symbol | Min | Typ | Max | Unit |
|------------------------------------|------------------|-----|-----|-----|------|
| Enable cycle time | t_{cycE} | 500 | - | - | ns |
| Enable pulse width (high level) | PW_{EH} | 230 | - | - | ns |
| Enable rise/fall time | t_{Er}, t_{Ef} | - | - | 20 | ns |
| Address set-up time (RS, R/W to E) | t_{AS} | 40 | - | - | ns |
| Address hold time | t_{AH} | 10 | - | - | ns |
| Data delay time | t_{DDR} | - | - | 100 | ns |
| Data hold time | t_{DHR} | 5 | - | - | ns |

12.6 Initializing soft ware of LCM

4-bit interface



8-bit interface



13. Outline drawing

