# SPECIFICATIONS FOR LCD MODULE

**MODEL NO.**
**BC2004C series**

FOR MESSRS:

_____

ON DATE OF:

_____

APPROVED BY:

_____

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## History of Version

| Version | Contents | Date | Note |
|---|---|---|---|
| 01 | NEW VERSION | 2005/09/05 | SPEC. |
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# CONTENTS


1. Numbering System .....4

2. Precautions in use of LCD Modules .....5

3. General Specification .....5

4. Absolute Maximum Rating .....6

5. Electrical Characteristics .....7

6. Optical Characteristics .....7

7. Interface Pin Function .....9

8. Power supply for LCD Module and LCD operating voltage adjustment .....10

9. Backlight information .....11

10. Quality Assurance .....14

11. Reliability .....17

12. Appendix (Drawing , EL inverter data , KS0066 controller data) .....18

    12-1 Drawing

    12-2 KS0066 controller data

        12-2.1 Function description

        12-2.2 C.G ROM table. table 2

        12-2.3 Instruction table

        12-2.4 Timing characteristics

        12-2.5 Initializing soft ware of LCM

## 1. Numbering System

| | B | C | 2004 | C | G | P | L | E | B | xxx |
|---|---|---|---|---|---|---|---|---|---|---|
| | 0 | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 |

| | | | |
|---|---|---|---|
| 0 | Brand | Bolymin | |
| 1 | Module Type | C= character type<br>G= graphic type<br>P= TAB/TCP type | O= COG type<br>F= COF type |
| 2 | Format | 2002=20 characters, 4 lines<br>12232= 122 x 32 dots | |
| 3 | Version No. | A type | |
| 4 | LCD Color | G=STN/gray<br>Y=STN/yellow-green<br>C=color STN | B=STN/blue<br>F=FSTN<br>T=TN |
| 5 | LCD Type | R=positive/reflective<br>P=positive/transflective | M=positive/transmissive<br>N=negative/transmissive |
| 6 | Backlight type/color | L=LED array/ yellow-green<br>H=LED edge/white<br>R=LED array/red<br>G=LEDedge/yellow-green<br>F=RGB | D=LED edge/blue<br>E=EL/white<br>B=EL/blue<br>C=CCFL/white<br>Y=LED Bottom/yellow<br>O=LED array/orangr<br>K=LED edge/green |
| 7 | CGRAM Font (applied only on character type) | J=English/Japanese Font<br>E=English/European Font | C=English/Cyrillic Font<br>H=English/Hebrew Font |
| 8 | View Angle/ Operating Temperature | B=Bottom/Normal Temperature<br>H=Bottom/Wide Temperature<br>U=Bottom/Ultra wide Temperature | T=Top/Normal Temperature<br>W=Top/Wide Temperature<br>C=9H/Normal Temperature |
| 9 | Special Code | 3=3 volt logic power supply<br>n=negative voltage for LCD<br>c=cable/connector<br>xxx=to be assigned on data sheet | t=temperature compensation for LCD<br>p=touch panel |

## 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 elastmer connecter, especially insert a backlight panel (EL or CCFL)

## 3. General Specification

(1) Mechanical Dimension

| Item | Dimension | Unit |
|---|---|---|
| Number of Characters | 20characters x4 Lines | — |
| Module dimension<br>( L x W x H ) | 118.0 x 43.0 x 13.1 (Max)—LED B/L<br>118.0 x 43.0 x 8.8 (Max)—EL or No B/L | mm |
| View area | 77.0 x 25.2 | mm |
| Active area | 70.4 x 20.8 | mm |
| Dot size | 0.55 x 0.55 | mm |
| Dot pitch | 0.60 x 0.60 | mm |
| Character size ( L x W ) | 2.95 x 4.75 | mm |
| Character pitch ( L x W ) | 3.55 x 5.35 | mm |

(2) Controller IC: **KS0066 (or Equivalent) controller**

(3) Temperature Range

| | Normal | Wide |
|---|---|---|
| Operating | 0 ~+50℃ | -20 ~+70℃ |
| Storage | -10 ~+60℃ | -30 ~+80℃ |

# 4. Absolute Maximum Ratings

4.1 Electrical Absolute Maximum Ratings (Vss=0V, Ta=25℃)

| Item | Symbol | Min | Max | Unit |
|---|---|---|---|---|
| Supply Voltage (Logic) | Vdd-Vss | -0.3 | 7 | V |
| Supply Voltage (LCD driver) | Vdd-Vo | -0.3 | 13 | V |
| Input Voltage | VI | Vss | Vdd | V |
| Normal Type | TOP | 0 | +50 | ℃ |
| | TSTG | -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) Ta = 0℃ ： 50Hr Max.

Note (2) Ta≦40℃ ：90% RH MAX

Ta > 40℃ ：Absolute humidity must be lower than the humidity of 90% at 40℃

## 5. Electrical Characteristics

| Item | Symbol | Condition | Min | Typ | Max | Unit |
|---|---|---|---|---|---|---|
| Supply Voltage For Logic | Vdd-Vss | - | 4.5 | - | 5.5 | V |
| Supply Voltage For LCD<br>＊Wide Temp、Type | Vdd-Vo | ＊Ta=-20℃ | - | 5.5 | - | V |
| | | Ta=0℃ | - | - | - | V |
| | | Ta=25℃ | - | **4.5** | - | V |
| | | Ta=50℃ | - | - | - | V |
| | | ＊Ta=+70℃ | - | 3.8 | - | V |
| Input High Volt. | $V_{IH}$ | - | 2.2 | - | Vdd | V |
| Input Low Volt. | $V_{IL}$ | - | — | - | 0.6 | V |
| Output High Volt. | $V_{OH}$ | - | 2.4 | - | - | V |
| Output Low Volt. | $V_{OL}$ | - | - | - | 0.4 | V |
| Supply Current | Idd | Vdd=5V | - | 1.6 | - | mA |

## 6. Optical Characteristics

a. STN

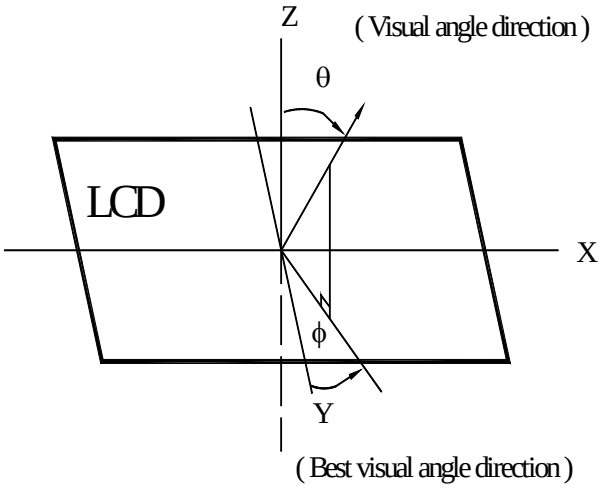
| Item | Symbol | Condition | Min. | Typ. | Max. | Unit |
|---|---|---|---|---|---|---|
| View Angle | (V) $\theta$ | CR≧2 | 10 | - | 45 | deg |
| | (H) $\varphi$ | CR≧2 | -30 | - | 30 | deg |
| Contrast Ratio | CR | - | - | 3 | - | - |
| Response Time 25℃ | T rise | - | - | 100 | 150 | ms |
| | T fall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

b. FSTN

| Item | Symbol | Condition | Min. | Typ. | Max. | Unit |
|---|---|---|---|---|---|---|
| View Angle | (V) $\theta$ | CR≧3 | 10 | - | 60 | deg |
| | (H) $\varphi$ | CR≧3 | -45 | - | 45 | deg |
| Contrast Ratio | CR | - | - | 5 | - | - |
| Response Time 25℃ | T rise | - | - | 100 | 150 | ms |
| | T fall | - | - | 150 | 200 | ms |

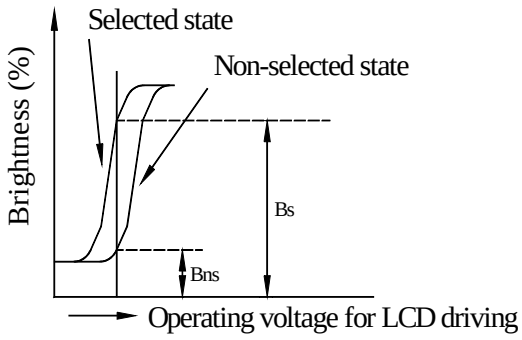
## 6.1 Definitions

■View Angles

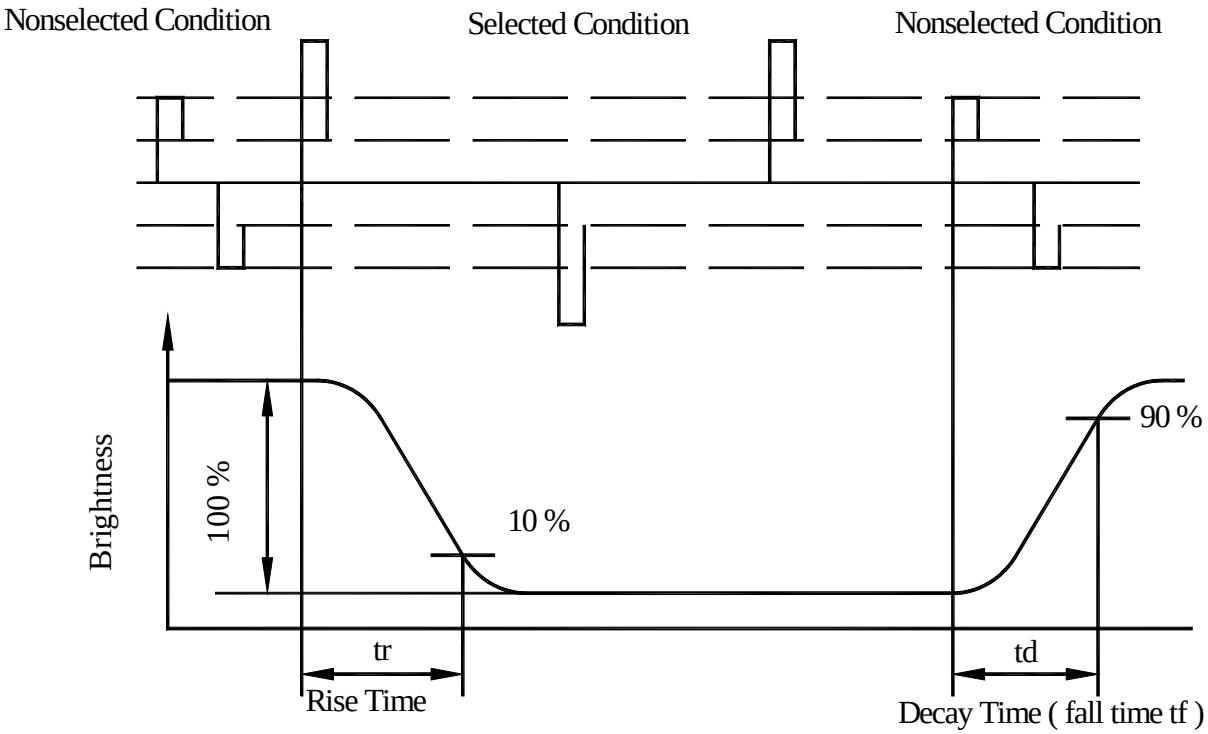



■Contrast Ratio

$$CR = \frac{\text{Brightness at selected state ( BS )}}{\text{Brightness at non-selected state ( Bns )}}$$




■Response Time

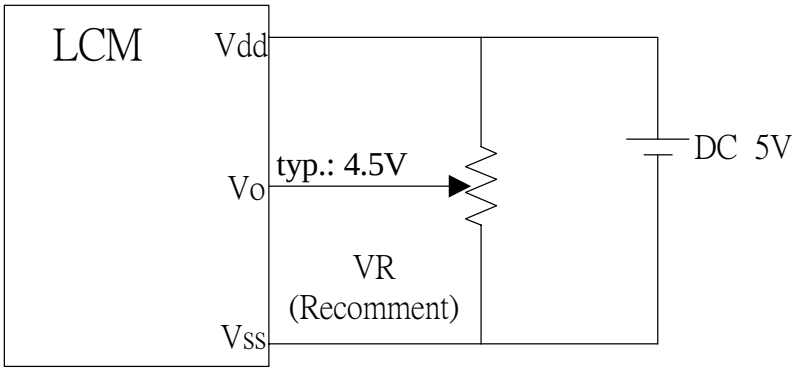


## 7. Interface Pin Function

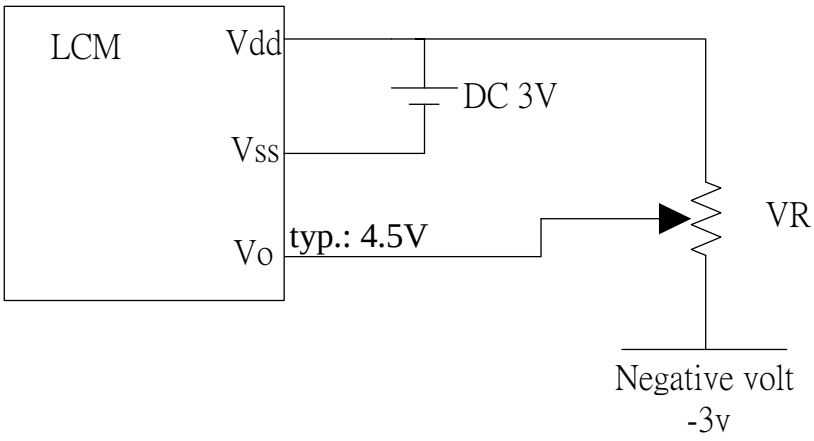
| Pin No. | Symbol | Level | Description |
|---|---|---|---|
| 1 | Vss | 0V | Ground |
| 2 | Vdd | 5.0V | Supply Voltage for logic **(+3V option)** |
| 3 | Vo | (Variable) | Operating voltage for LCD |
| 4 | RS | H/L | H:DATA, L:Instruction code |
| 5 | R/W | H/L | H:Read(MPU→Module)L:Write(MPU→Module)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

## 8. Power Supply for LCD Module and LCD Operating Voltage a Adjustment

＊Standart Type




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



## 9. Backlight Information

9.1 Specification

(1) LED array / yellow-green

| Parameter | Symbol | Min | Typ | Max | Unit | Test Condition |
|---|---|---|---|---|---|---|
| Supply Current | ILED | - | 280 | - | mA | V=4.2V |
| Supply Voltage | V | - | 4.2 | 4.3 | V | - |
| Reverse Voltage | VR | - | - | 8 | V | - |
| Luminous Intensity | IV | 60 | - | - | cd / $m^2$ | ILED=280mA |
| Wave Length | λ p | - | 574 | - | nm | ILED=280mA |
| Life Time | - | - | 100000 | - | Hr. | V≦4.2 |
| Color | Yellow Green | | | | | |

(2) LED edge / white

| Parameter | Symbol | Min | Typ | Max | Unit | Test Condition |
|---|---|---|---|---|---|---|
| Supply Current | ILED | - | 60 | - | mA | V= 3.5V |
| Supply Voltage | V | - | 3.5 | 3.7 | V | - |
| Reverse Voltage | VR | - | - | 8 | V | - |
| Luminous Intensity | IV | 50 | - | - | cd/$m^2$ | ILED=60 mA |
| Life Time | - | - | 10000 | - | Hr. | V≦3.7 V |
| Color | white | | | | | |

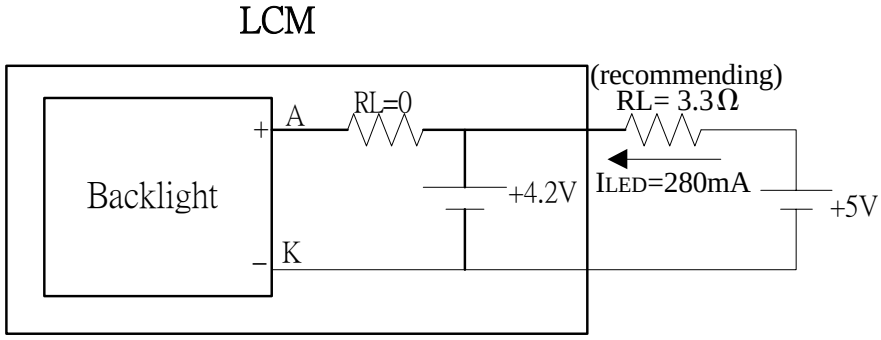
(3) EL white / blue

| Parameter | Symbol | Min | Typ | Max | Unit | Test Condition |
|---|---|---|---|---|---|---|
| Drive Voltage | Vmax | - | 110 | 170 | Vrms | 25°C |
| Drive Wave | Fmax | - | 400 | 1000 | Hz | 25°C |
| Brightness | - | 20 | - | - | cd/m$^2$ | 110V/400Hz |
| Power Consumption | - | - | 48.3 | - | mW | 110V/400Hz |
| Chromatism | X | - | 0.3019 (white)<br>0.330 (blue) | - | - | 110V/400Hz |
| | Y | - | 0.3929 (white)<br>0.365 (blue) | - | - | 110V/400Hz |
| Life time | 5000 | | | | hour | 110V/400Hz |
| Color | White / Blue | | | | - | Light on 110V/400Hz |

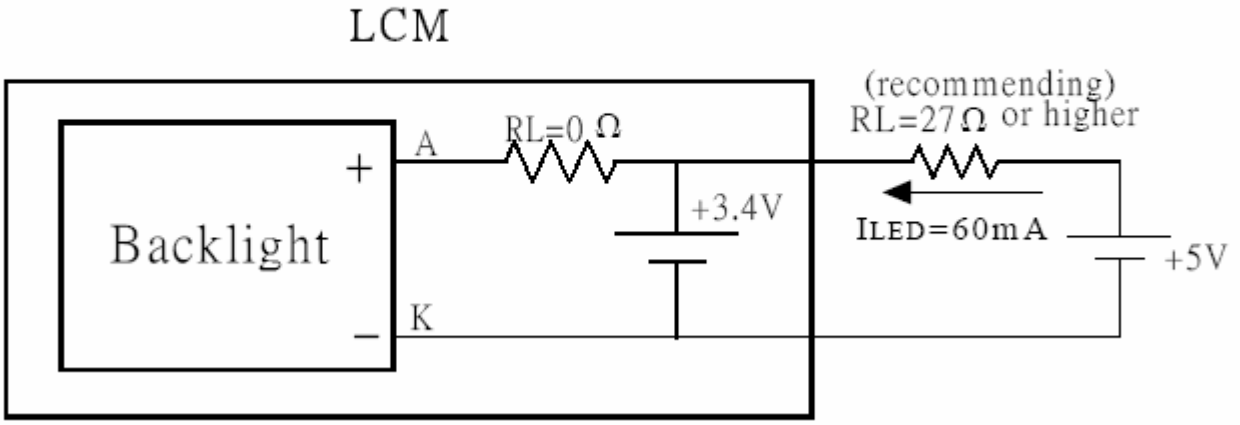
9.2 Backlight driving methods

a. LED B/L drive from A.K directly

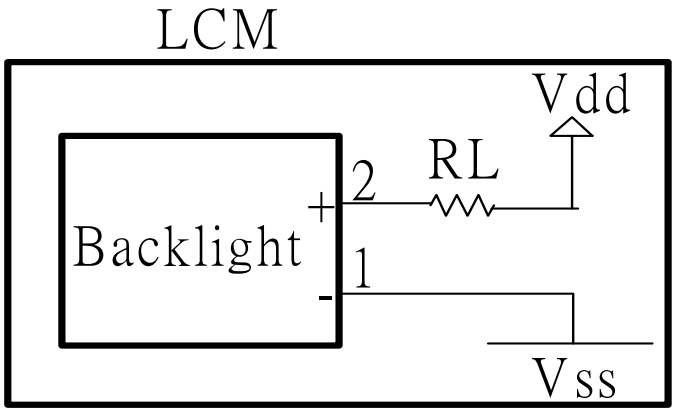
a.1 array / yellow-green



a.2 edge / white

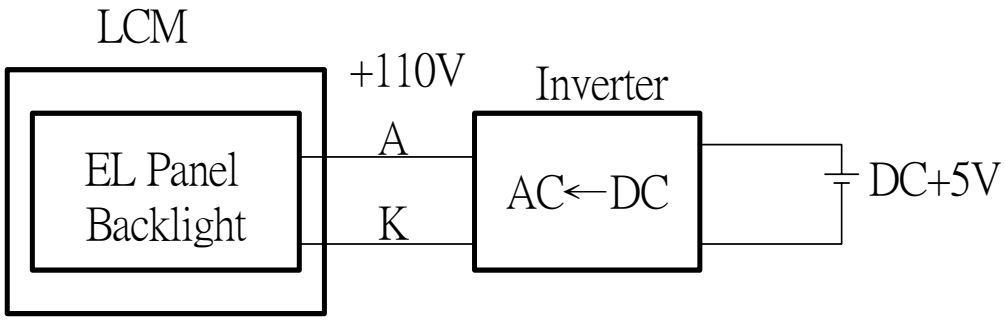



b. ∗ **(O**ption) LED B/L drive from pin1 (Vss) pin2 (Vdd)




(1) Jump 1,2 Short
(2) Current Resistor required on RL
(3) To be sure of enough current supply for both Vdd + LED B/L

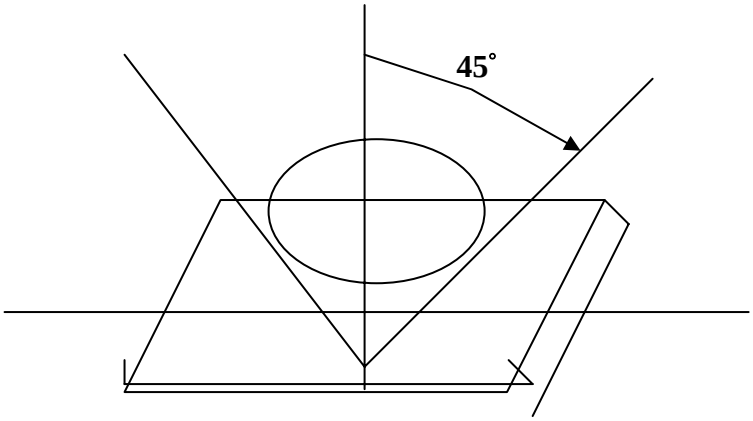
c. EL B/L drive from A.K directly



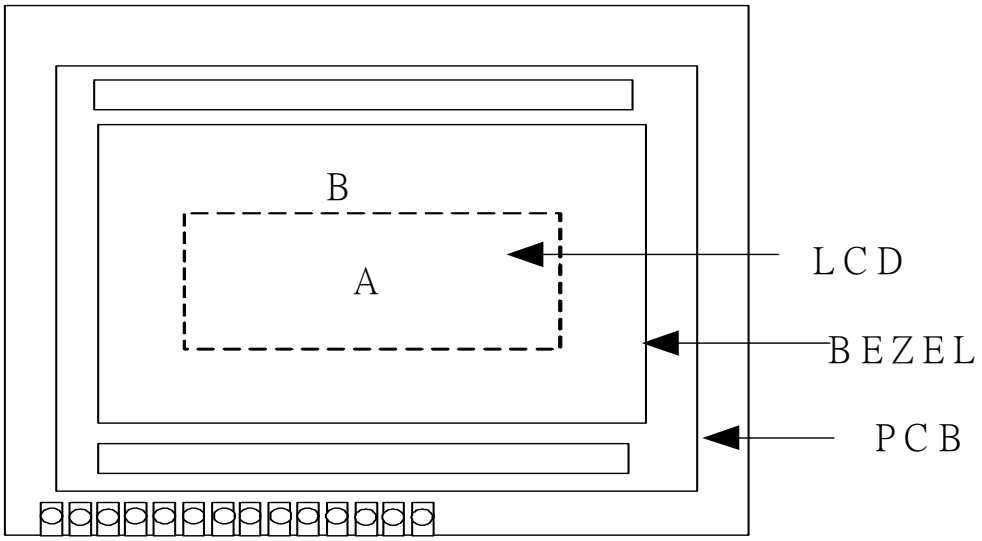
## 10. Quality Assurance

10.1 Inspection conditions

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




Definition of applicable Zones

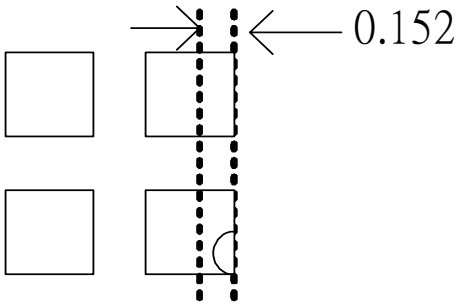
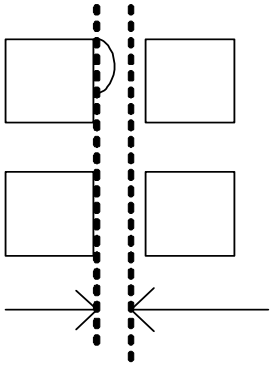
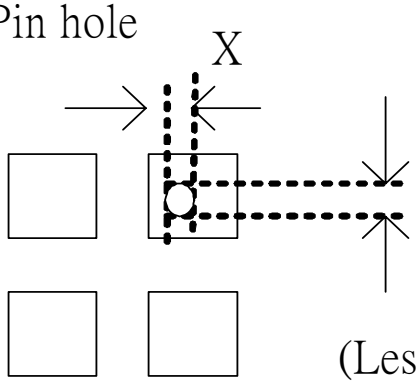
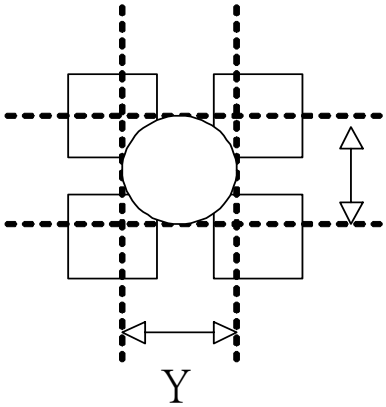



A : Display Area

B : Non-Display Area

10.2 Inspection Parameters

<table>
<tr><th>NO.</th><th>Parameter</th><th>Criteria</th></tr>
<tr><td>1</td><td>Black or White spots</td><td>
<table>
<tr><th>Zone<br>Dimension</th><th colspan="2">Acceptable Number</th><th>Class Of Defects</th><th>Acceptable Level</th></tr>
<tr><td></td><td>A</td><td>B</td><td></td><td></td></tr>
<tr><td>D＜0.15</td><td>*</td><td>*</td><td rowspan="4">Minor</td><td rowspan="4">2.5</td></tr>
<tr><td>0.15≦D≦0.2</td><td>4</td><td>4</td></tr>
<tr><td>0.2≦D≦0.25</td><td>2</td><td>2</td></tr>
<tr><td>D≦0.3</td><td>0</td><td>1</td></tr>
</table>
D=(Long + Short)/2 *: Disregard
</td></tr>
<tr><td>2</td><td>Scratch, Substances</td><td>
<table>
<tr><th colspan="2">Zone<br>X(mm) Y(mm)</th><th colspan="2">Acceptable Number</th><th>Class Of Defects</th><th>Acceptable Level</th></tr>
<tr><td></td><td></td><td>A</td><td>B</td><td></td><td></td></tr>
<tr><td>*</td><td>0.04≧W</td><td>*</td><td>*</td><td rowspan="4">Minor</td><td rowspan="4">2.5</td></tr>
<tr><td>3.0≧L</td><td>0.06≧W</td><td>4</td><td>4</td></tr>
<tr><td>2.0≧L</td><td>0.08≧W</td><td>2</td><td>3</td></tr>
<tr><td>—</td><td>0.1＜W</td><td>0</td><td>1</td></tr>
</table>
X: Length Y: Width *: Disregard<br>
Total defects should not exceed 4/module
</td></tr>
<tr><td>3</td><td>Air Bubbles ( between glass & polarizer)</td><td>
<table>
<tr><th>Zone<br>Dimension</th><th colspan="2">Acceptable Number</th><th>Class Of Defects</th><th>Acceptable Level</th></tr>
<tr><td></td><td>A</td><td>B</td><td></td><td></td></tr>
<tr><td>D≦0.15</td><td>*</td><td>*</td><td rowspan="3">Minor</td><td rowspan="3">2.5</td></tr>
<tr><td>0.15＜D≦0.25</td><td>2</td><td>*</td></tr>
<tr><td>0.25＜D</td><td>0</td><td>1</td></tr>
</table>
*: Disregard<br>
Total defects shall not excess 3/module.
</td></tr>
</table>

| | | |
|---|---|---|
| 4 | Uniformity | (1) Pixel shape (with Dent)<br><br><br>(2) Pixel shape (With Projection)<br><br><br>(3) Pin hole<br><br><br>(X+Y)/2≦0.02mm<br>(Less than 0.1mm is no counted)<br>(4)Deformation<br><br><br>(X+Y)/2 ≦0.3mm<br>Total acceptable number : 1/pixel,5/cell |

## 11. Reliability

■Content of Reliability Test

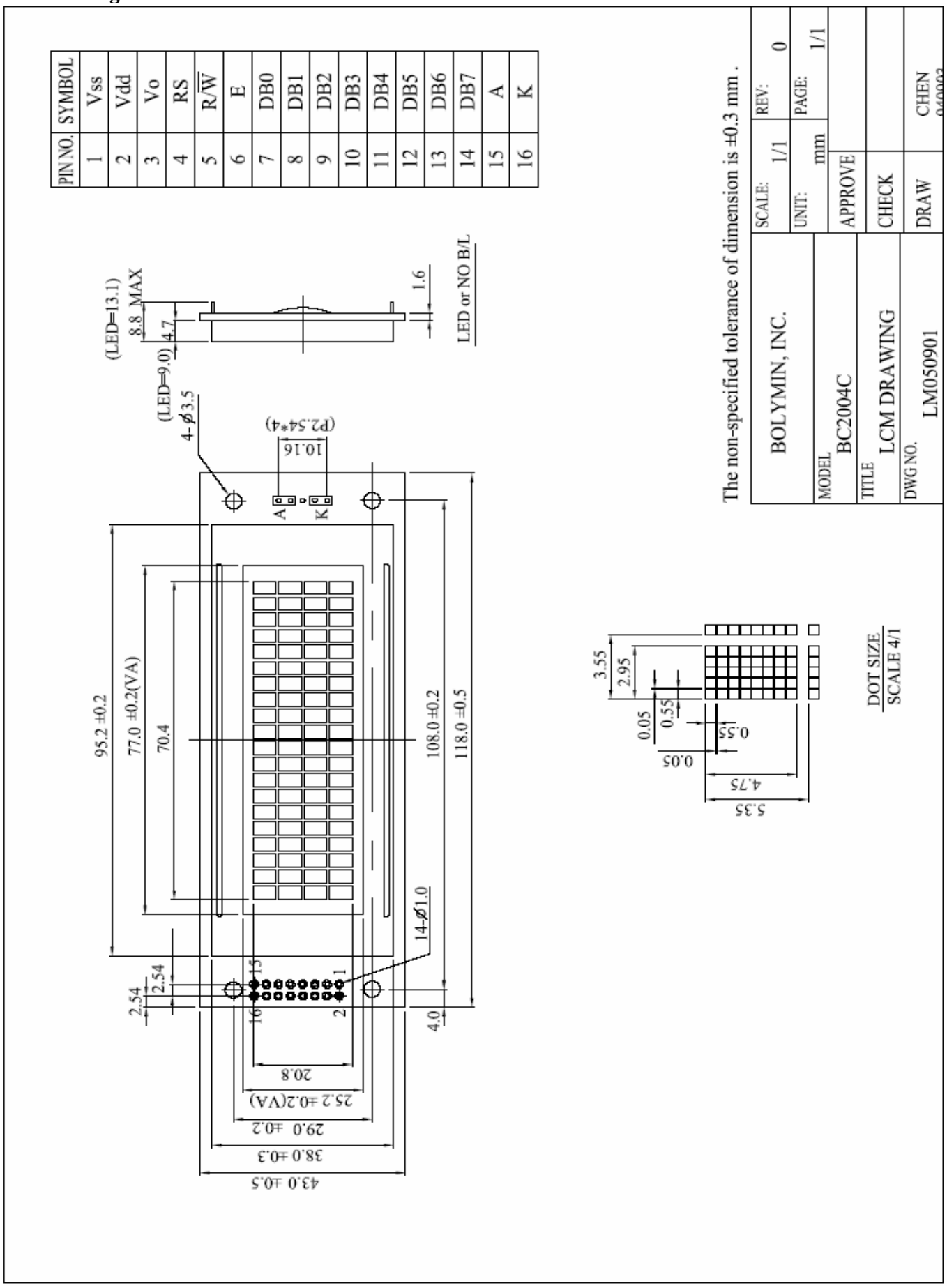
| Environmental Test | | | | |
|---|---|---|---|---|
| No. | Test Item | Content of Test | Test Condition | Applicable Standard |
| 1 | High Temperature storage | Endurance test applying the high storage temperature for a long time. | 60℃<br>200hrs | - |
| 2 | Low Temperature storage | Endurance test applying the high storage temperature for a long time. | -20℃<br>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℃<br>200hrs | - |
| 4 | Low Temperature Operation | Endurance test applying the electric stress under low temperature for a long time. | 0℃<br>200hrs | - |
| 5 | High Temperature/ Humidity Storage | Endurance test applying the high temperature and high humidity storage for a long time. | 60℃,90%RH<br>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<br>96hrs | - |
| 7 | Temperature Cycle | Endurance test applying the low and high temperature cycle.<br>-20℃ 25℃ 60℃<br>30min 5min 30min 1 cycle | -20℃/60℃<br>10 cycles | - |
| Mechanical Test | | | | |
| 8 | Vibration test | Endurance test applying the vibration during transportation and using. | 10~22Hz→1.5mmp-p<br>22~500Hz→1.5G<br>Total 0.5hrs | - |
| 9 | Shock test | Constructional and mechanical endurance test applying the shock during transportation. | 50G Half sign wave 11 msedc<br>3 times of each direction | - |
| 10 | Atmospheric pressure test | Endurance test applying the atmospheric pressure during transportation by air. | 115mbar<br>40hrs | - |
| Others | | | | |
| 11 | Static electricity test | Endurance test applying the electric stress to the terminal. | VS=800V,RS=1.5kΩ<br>CS=100pF 1 time | - |

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

# 12. Appendix ( Drawing , KS0066 controller data)

## 12-1 Drawing

| PIN NO. | SYMBOL |
|---|---|
| 1 | Vss |
| 2 | Vdd |
| 3 | Vo |
| 4 | RS |
| 5 | R/$\overline{W}$ |
| 6 | E |
| 7 | DB0 |
| 8 | DB1 |
| 9 | DB2 |
| 10 | DB3 |
| 11 | DB4 |
| 12 | DB5 |
| 13 | DB6 |
| 14 | DB7 |
| 15 | A |
| 16 | K |



## 12-2. KS0066 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)

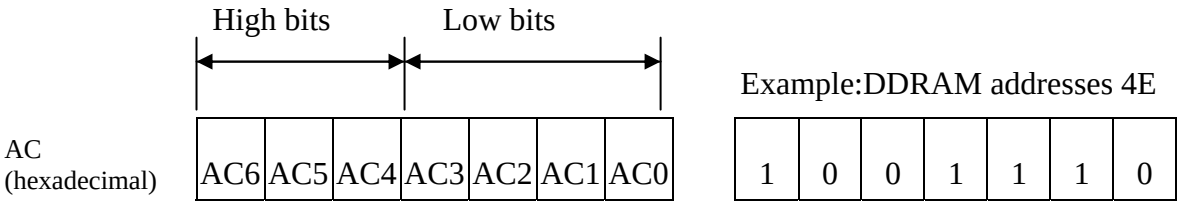
When the busy flag is 1, the controller LSI is in the internal operation mode, and the next instruction will not be accepted. When RS=0 and R/W=1, the busy flag is output to DB7. The next instruction must be written after ensuring that the busy flag is 0.

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)
12-2.2 C.G ROM table. table 2

For 5 * 8 dot character patterns

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

For 5 * 10 dot character patterns

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

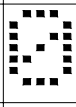
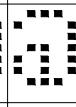
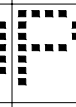
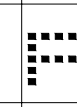
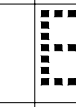
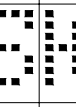
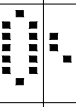
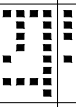
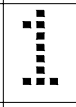
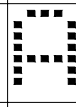
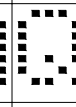
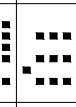
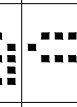
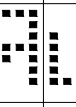
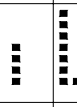
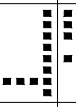
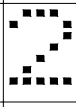
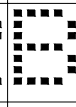
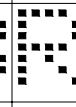
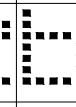
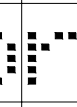
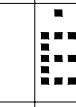
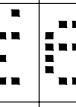
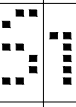
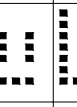
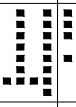
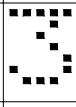
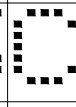
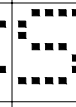
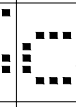
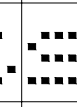
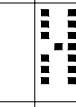
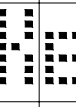
## Code J: English – Japanese Font

| 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) | | | | | | | | | | | | | | | |
| 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 E: English - European Fon

| 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 C: 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) | | |  |  |  |  |  | | |  |  |  |  |  |  |
| 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) | | |  |  |  |  |  | | |  |  |  |  |  |  |

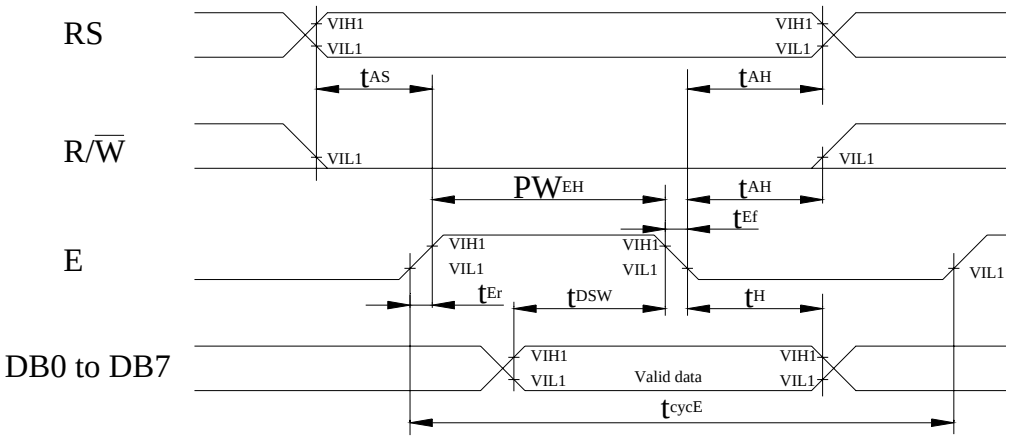
12-2.3 Instruction table

| 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 | 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 | 1 | I/D | SH | Assign cursor moving direction and enable the shift of entire display. | 39 $\mu$s |
| 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. | 39 $\mu$s |
| 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. | 39 $\mu$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 $\mu$s |
| Set CGRAM Address | 0 | 0 | 0 | 1 | AC5 | AC4 | AC3 | AC2 | AC1 | AC0 | Set CGRAM address in address counter. | 39 $\mu$s |
| Set DDRAM Address | 0 | 0 | 1 | AC6 | AC5 | AC4 | AC3 | AC2 | AC1 | AC0 | Set DDRAM address in address counter. | 39 $\mu$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 $\mu$s |
| Write Data to RAM | 1 | 0 | D7 | D6 | D5 | D4 | D3 | D2 | D1 | D0 | Write data into internal RAM (DDRAM/CGRAM). | 43 $\mu$s |
| Read Data from RAM | 1 | 1 | D7 | D6 | D5 | D4 | D3 | D2 | D1 | D0 | Read data from internal RAM (DDRAM/CGRAM). | 43 $\mu$s |

—”：don’t care

12-2.4 Timing characteristics

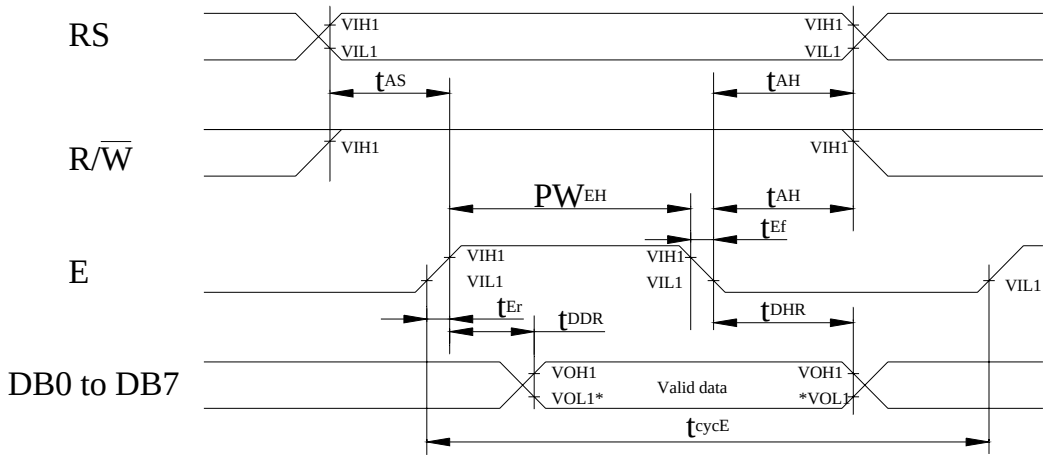
12-2.4.1 Write Operation




Ta=25℃,Vdd=5.0±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 set-up time | $t_{DSW}$ | 80 | - | - | ns |
| Data hold time | $t_{H}$ | 10 | - | - | ns |

12-2.4.2 Read Operation




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

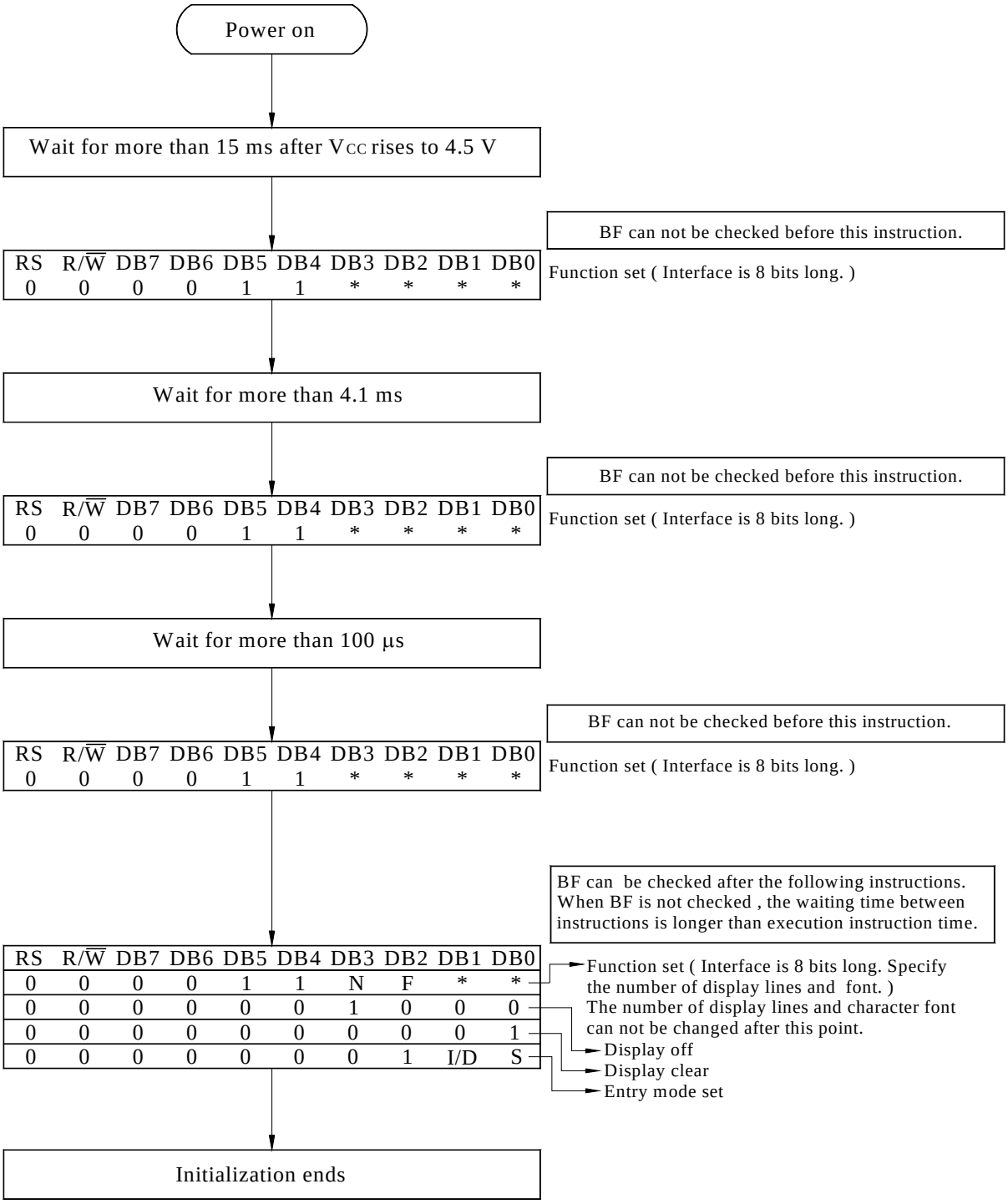
Ta=25℃,Vdd=5.0±0.5V

| 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 | $t_{DDR}$ | - | - | 160 | ns |
| Data hold time | $t_{DHR}$ | 5 | - | - | ns |

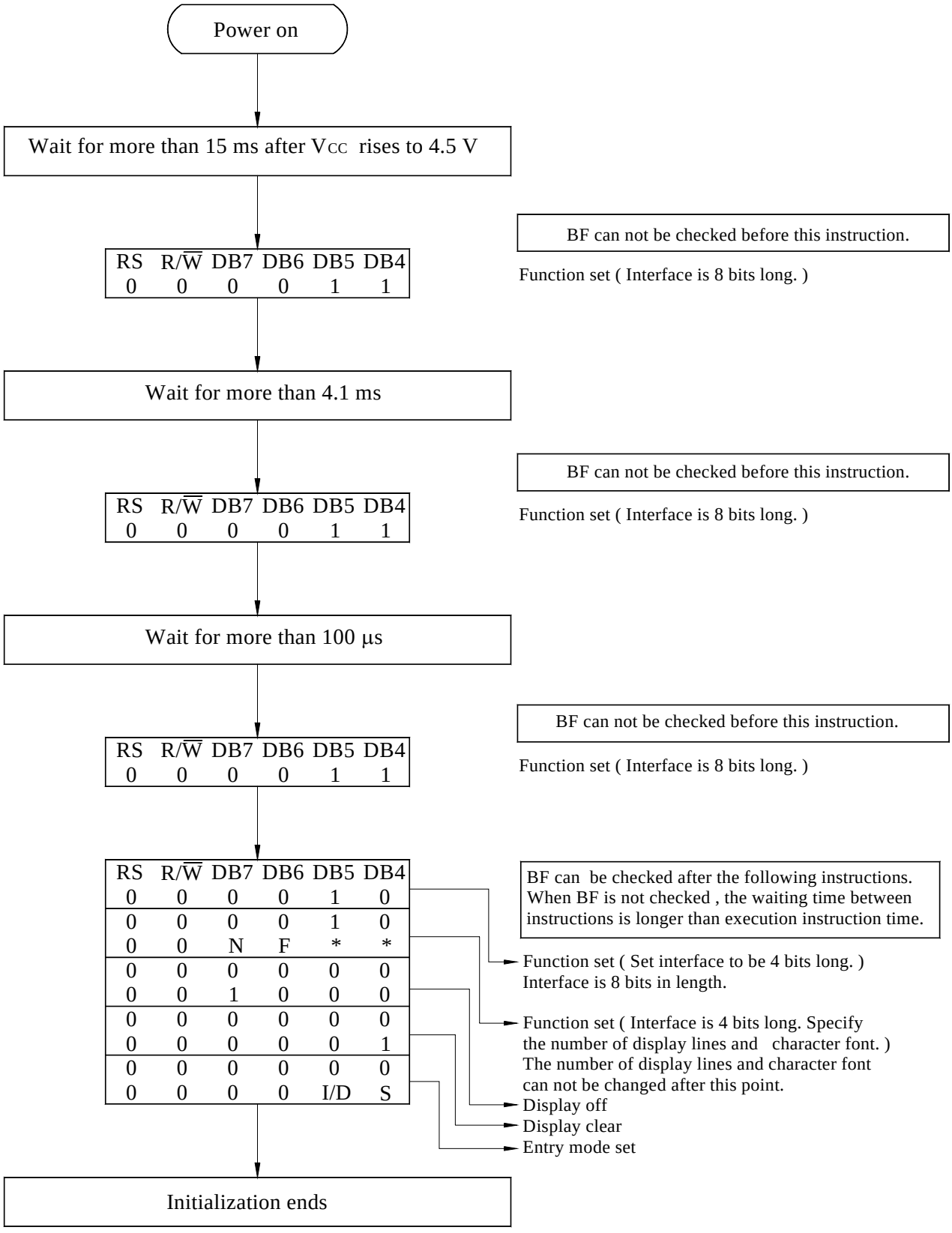
12-2.5 Initializing soft ware of LCM

12-2.5.1 8-bit interface

12-2.5.2 4-bit interface




8-Bit Ineterface




4-Bit Ineterface