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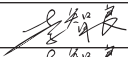
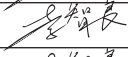
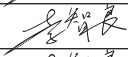
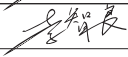
# Specification

## MC21605A6WK-BNMLW



# BOOKBINDING AREA

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| NO. | DATE    | DESCRIPTION                                 | ITEM | PAGE        | APPROVED                                                                            |
|-----|---------|---------------------------------------------|------|-------------|-------------------------------------------------------------------------------------|
| 1   | 2005.05 | INITIAL ISSUED                              | ALL  | ALL         | LU BOO                                                                              |
| 2   | 2007.04 | Added further information of LED backlight  | 4    | 4/20        |  |
| 3   | 2008.01 | Adopt logos on the cover for fast reference | -    | Cover       |  |
| 4   | 2008.10 | Deleted "N = No Ic" from CODE2              | -    | Code System |  |
| 5   | 2008.10 | Added CODE "B" for DFSTN version in CODE7   | -    | Code System |  |





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## Midas LCD Part Number System

|           |            |               |          |          |          |          |          |          |          |           |           |           |           |           |           |           |
|-----------|------------|---------------|----------|----------|----------|----------|----------|----------|----------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|
| <b>MC</b> | <b>COG</b> | <b>132033</b> | <b>A</b> | <b>*</b> | <b>6</b> | <b>W</b> | <b>*</b> | <b>*</b> | <b>-</b> | <b>S</b>  | <b>N</b>  | <b>T</b>  | <b>L</b>  | <b>W</b>  | <b>*</b>  | <b>*</b>  |
| <b>1</b>  | <b>2</b>   | <b>3</b>      | <b>4</b> | <b>5</b> | <b>6</b> | <b>7</b> | <b>8</b> | <b>9</b> | <b>-</b> | <b>10</b> | <b>11</b> | <b>12</b> | <b>13</b> | <b>14</b> | <b>15</b> | <b>16</b> |

1 = **MC:** Midas Components

2 = **Blank:** COB (chip on board) **COG:** chip on glass

3 = **No of dots** (e.g. 240064 = 240 x 64 dots) (e.g. 21605 = 2 x 16 5mm C.H.)

4 = **Series**

5 = **Series Variant:** A to Z – **see addendum**

6 = **3:** 3 o'clock **6:** 6 o'clock **9:** 9 o'clock **12:** 12 o'clock

7 = **S:** Normal (0 to + 50 deg C) **W:** Wide temp. (-20 to + 70 deg C) **X:** Extended temp (-30 + 80 Deg C)

8 = **Character Set**

**Blank:** Standard (English/Japanese)

**C:** Chinese Simplified (Graphic Displays only)

**CB:** Chinese Big 5 (Graphic Displays only)

**H:** Hebrew

**K:** European (std) (English/German/French/Greek)

**L:** English/Japanese (special)

**M:** European (English/Scandinavian)

**R:** Cyrillic

**W:** European (English/Greek)

**U:** European (English/Scandinavian/Icelandic)

9 = **Bezel Height** (where applicable / available)

|              | Top of Bezel to Top<br>of PCB | Common<br>(via pins 1<br>and 2) | Array<br>or Edge<br>Lit |
|--------------|-------------------------------|---------------------------------|-------------------------|
| <b>Blank</b> | 9.5mm / not<br>applicable     | Common                          | Array                   |
| <b>2</b>     | 8.9 mm                        | Common                          | Array                   |
| <b>3</b>     | 7.8 mm                        | Separate                        | Array                   |
| <b>4</b>     | 7.8 mm                        | Common                          | Array                   |
| <b>5</b>     | 9.5 mm                        | Separate                        | Array                   |
| <b>6</b>     | 7 mm                          | Common                          | Array                   |
| <b>7</b>     | 7 mm                          | Separate                        | Array                   |
| <b>8</b>     | 6.4 mm                        | Common                          | Edge                    |
| <b>9</b>     | 6.4 mm                        | Separate                        | Edge                    |
| <b>A</b>     | 5.5 mm                        | Common                          | Edge                    |
| <b>B</b>     | 5.5 mm                        | Separate                        | Edge                    |
| <b>D</b>     | 6.0mm                         | Separate                        | Edge                    |
| <b>E</b>     | 5.0mm                         | Separate                        | Edge                    |
| <b>F</b>     | 4.7mm                         | Common                          | Edge                    |
| <b>G</b>     | 3.7mm                         | Separate                        | EL                      |

10 = **T:** TN **S:** STN **B:** STN Blue **G:** STN Grey **F:** FSTN **F2:** FFSTN

11 = **P:** Positive **N:** Negative

12 = **R:** Reflective **M:** Transmissive **T:** Transflective

13 = **Backlight:** **Blank:** Reflective **L:** LED

14 = **Backlight Colour:** **Y:** Yellow-Green **W:** White **B:** Blue **R:** Red **A:** Amber **O:** Orange **G:** Green **RGB:** R.G.B.

15 = **Driver Chip:** **Blank:** Standard **I:** I<sup>2</sup>C **T:** Toshiba T6963C **A:** Avant SAP1024B **R:** Raio RA8835

16 = **Voltage Variant:** e.g. 3 = 3v

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## 1. GENERAL SPECIFICATIONS

| ITEM                      | NOMINAL DIMENSIONS / AVAILABLE OPTIONS |
|---------------------------|----------------------------------------|
| DISPLAY FORMAT            | 16 Characters by 2 Lines               |
| LCD PANEL OPTIONS         | STN (Blue color)                       |
| POLARIZER OPTIONS         | Negative, Transmissive                 |
| BACKLIGHT OPTIONS         | Edge type LED backlight (White color)  |
| VIEWING ANGLE OPTIONS     | 6:00 ( Bottom )                        |
| TEMPERATURE RANGE OPTIONS | Wide temp. range ( -20℃ ~ 70℃ )        |
| CONTROLLER IC             | SUNPLUS                                |
| DISPLAY DUTY              | 1/16                                   |
| DRIVING BIAS              | 1/5                                    |

## 2. MECHANICAL SPECIFICATIONS

|                       |                                                |    |                        |                |    |
|-----------------------|------------------------------------------------|----|------------------------|----------------|----|
| <b>OVERALL SIZE</b>   | LED backlight version : 84.0 x 44.0 x max 13.5 |    |                        |                | mm |
| <b>VIEWING AREA</b>   | 64.5W x 16.4H                                  | mm | <b>HOLE-HOLE</b>       | 79/76W x 36.0H | mm |
| <b>CHARACTER SIZE</b> | 3.00W x 5.23H                                  | mm | <b>CHARACTER PITCH</b> | 0.51W x 0.52H  | mm |
| <b>DOT SIZE</b>       | 0.56W x 0.61H                                  | mm | <b>DOT PITCH</b>       | 0.05W x 0.05H  | mm |

## 3. ABSOLUTE MAXIMUM RATINGS

| ITEM                  | SYMBOL | CONDITION | MIN       | MAX      | UNIT |
|-----------------------|--------|-----------|-----------|----------|------|
| POWER SUPPLY ( LOGIC) | Vdd    | 25℃       | -0.3      | 7.0      | V    |
| POWER SUPPLY (LCD)    | V0     | 25℃       | Vdd -13.5 | Vdd +0.3 | V    |
| INPUT VOLTAGE         | Vin    | 25℃       | -0.3      | Vdd +0.3 | V    |
| OPERATING TEMPERATURE | Vopr   | —         | -20       | 70       | ℃    |
| STORAGE TEMPERATURE   | Vstg   | —         | -30       | 80       | ℃    |

## 4. ELECTRONICAL CHARACTERISTIC\*

| ITEM                                                            | SYMBOL       | CONDITION     | STANDARD |      |      | UNIT              |
|-----------------------------------------------------------------|--------------|---------------|----------|------|------|-------------------|
|                                                                 |              |               | MIN      | TYP  | MAX  |                   |
| Input voltage                                                   | Vdd          | +5V           | 4.7      | 5.0  | 5.5  | V                 |
| Supply current                                                  | Idd          | Vdd=5V        | —        | 1.5  | —    | mA                |
| Recommended LCD driving voltage for normal temp. Version module | Vdd - V0     | -20℃          | 4.15     | —    | 4.60 | V                 |
|                                                                 |              | 0℃            | 4.10     | —    | 4.60 |                   |
|                                                                 |              | 25℃           | 4.10     | 4.40 | 4.60 |                   |
|                                                                 |              | 50℃           | 4.00     | —    | 4.50 |                   |
|                                                                 |              | 70℃           | 3.90     | —    | 4.40 |                   |
| LED forward voltage                                             | Vf           | 25℃           | 2.9      | —    | 3.4  | V                 |
| LED forward current                                             | If           | 25℃           | —        | 15   | 20   | mA                |
| LED reverse Current                                             | Ir           | 25℃           | —        | 10   | —    | μA                |
| LED color range                                                 | X coordinate | 25℃ If = 15mA | 0.25     | —    | 0.28 | —                 |
|                                                                 | Y coordinate | 25℃ If = 15mA | 0.26     | —    | 0.29 | —                 |
| LED illuminance (Without LCD)                                   | Lv           | 25℃ If = 15mA | 200      | —    | 300  | cd/m <sup>2</sup> |
| LED life time                                                   | —            | 25℃ If = 15mA | 9K**     | —    | —    | Hours             |

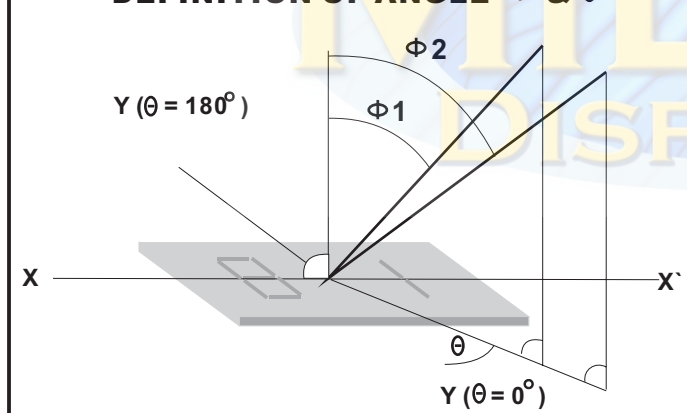
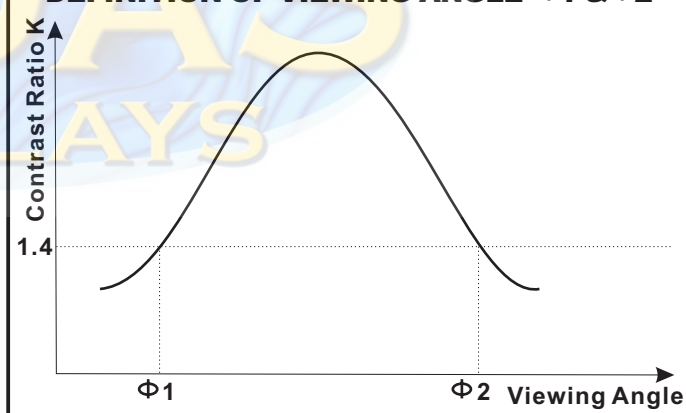
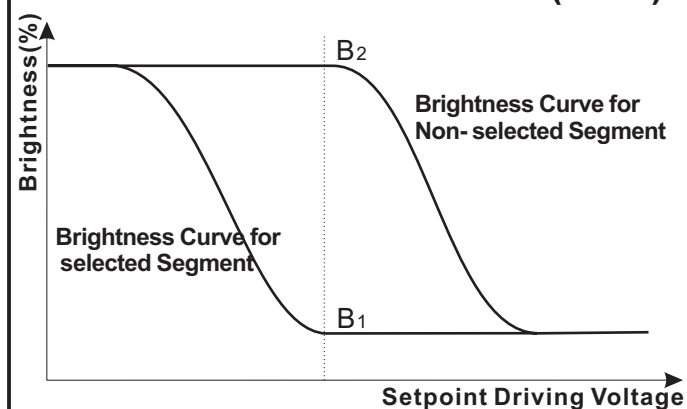
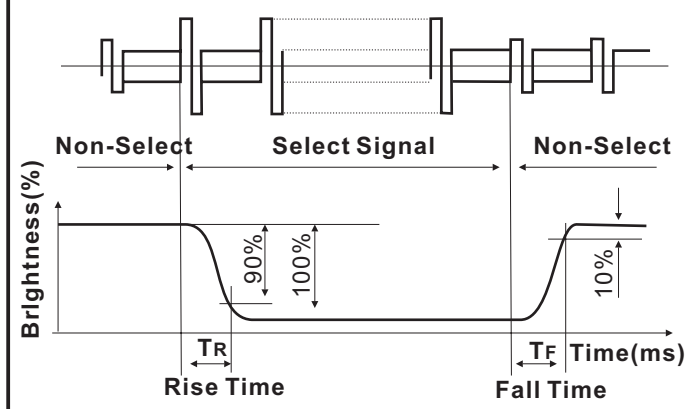
## 5. OPTICAL CHARACTERISTIC

FOR TN TYPE LCD MODULE ( $T_A=25^{\circ}\text{C}$ ,  $V_{dd}=5.0\text{V} \pm 0.25\text{V}$ )

| ITEM                | SYMBOL            | CONDITION | MIN | TYP | MAX | UNIT |
|---------------------|-------------------|-----------|-----|-----|-----|------|
| VIEWING ANGLE       | $\Phi 2 - \Phi 1$ | K=4       | 30  | —   | —   | deg  |
|                     | $\theta$          |           | 25  |     |     |      |
| CONTRAST RATIO      | K                 | —         | —   | 2   | —   | —    |
| RESPONSE TIME(RISE) | $T_R$             | —         | —   | 120 | 150 | ms   |
| RESPONSE TIME(FALL) | $T_F$             | —         | —   | 120 | 150 | ms   |

FOR STN TYPE LCD MODULE ( $T_A=25^{\circ}\text{C}$ ,  $V_{dd}=5.0\text{V} \pm 0.25\text{V}$ )

| ITEM                | SYMBOL            | CONDITION | MIN | TYP | MAX | UNIT |
|---------------------|-------------------|-----------|-----|-----|-----|------|
| VIEWING ANGLE       | $\Phi 2 - \Phi 1$ | K=4       | 40  | —   | —   | deg  |
|                     | $\theta$          |           | 60  |     |     |      |
| CONTRAST RATIO      | K                 | —         | —   | 6   | —   | —    |
| RESPONSE TIME(RISE) | $T_R$             | —         | —   | 150 | 250 | ms   |
| RESPONSE TIME(FALL) | $T_F$             | —         | —   | 150 | 250 | ms   |

DEFINITION OF ANGLE  $\Phi$  &  $\theta$ DEFINITION OF VIEWING ANGLE  $\Phi 1$  &  $\Phi 2$ DEFINITION OF CONTRAST RATIO  $K(=B_2/B_1)$ DEFINITION OF OPTICAL RESPONSE TIME  $T_R$  &  $T_F$ 

|  |                      |                   |             |             |
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## 6. ELECTRICAL SPECIFICATIONS

### 6.1 DC CHARACTERISTICS ( VDD = 4.5V to 5.5V, TA = 25 °C )

| CHARACTERISTICS             | SYMBOL           | LIMIT |      |                 | UNIT | TEST CONDITION                                        |
|-----------------------------|------------------|-------|------|-----------------|------|-------------------------------------------------------|
|                             |                  | MIN.  | TYP. | MAX.            |      |                                                       |
| INPUT HIGH VOLTAGE          | V <sub>IH1</sub> | 2.2   | ---  | V <sub>dd</sub> | V    | Pins ( E. RS. R/W. DB0 - DB7 )                        |
| INPUT LOW VOLTAGE           | V <sub>IL1</sub> | -0.3  | ---  | 0.6             | V    |                                                       |
| INPUT HIGH CURRENT          | I <sub>IH</sub>  | -2.0  | ---  | 2.0             | μA   | Pins ( RS. R/W. DB0 - DB7 )<br>V <sub>dd</sub> = 5.0V |
| INPUT LOW CURRENT           | I <sub>IL</sub>  | -20   | -50  | -100            | μA   |                                                       |
| OUTPUT HIGH VOLTAGE ( TTL ) | V <sub>OH1</sub> | 2.4   | ---  | V <sub>dd</sub> | V    | I <sub>OH</sub> = - 0.1mA<br>Pins: DB0 - DB7          |
| OUTPUT LOW VOLTAGE ( TTL )  | V <sub>OL1</sub> | ---   | ---  | 0.4             | V    | I <sub>OL</sub> = 0.1mA<br>Pins: DB0 - DB7            |

### 6.2 AC CHARACTERISTICS ( VDD = 4.5V to 5.5V, TA = 25 °C )

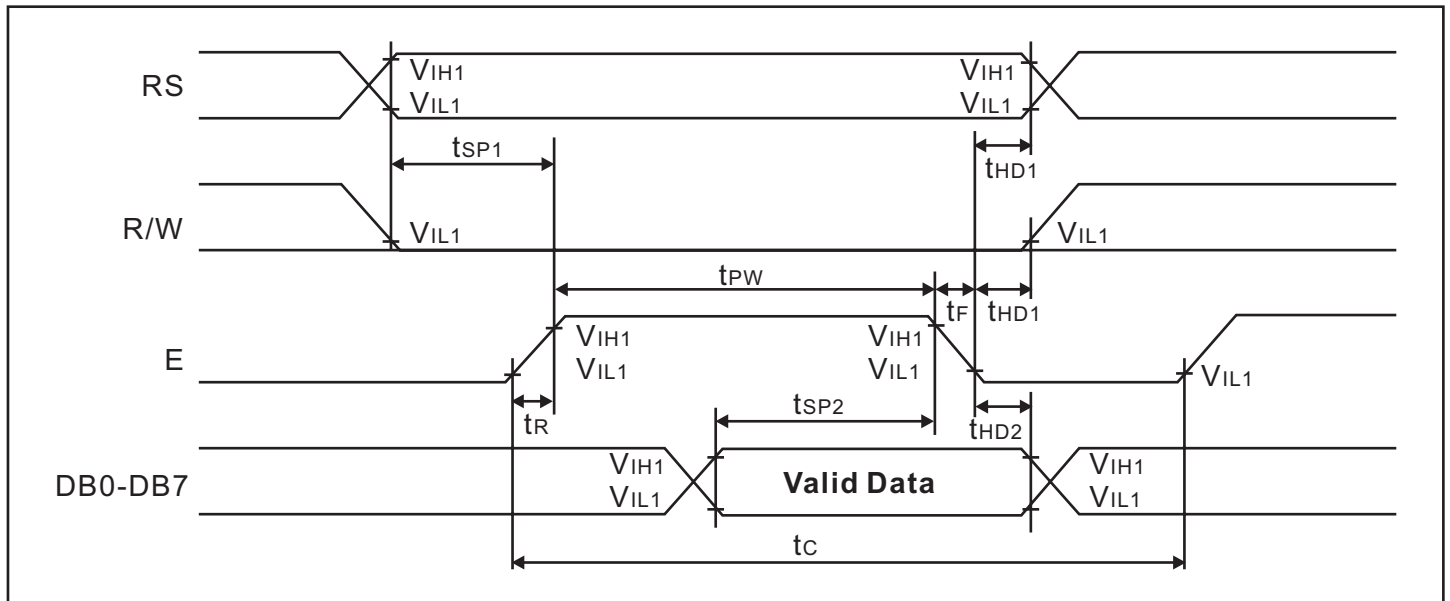
Write mode

| CHARACTERISTICS        | SYMBOL                          | LIMIT |      |      | UNIT | TEST CONDITION  |
|------------------------|---------------------------------|-------|------|------|------|-----------------|
|                        |                                 | MIN.  | TYP. | MAX. |      |                 |
| ENABLE CYCLE TIME      | t <sub>c</sub>                  | 500   | ---  | ---  | ns   | Pin E           |
| ENABLE PULSE WIDTH     | t <sub>PW</sub>                 | 230   | ---  | ---  | ns   | Pin E           |
| ENABLE RISE/ FALL TIME | t <sub>R</sub> , t <sub>F</sub> | ---   | ---  | 20   | ns   | Pin E           |
| ADDRESS SETUP TIME     | t <sub>SP1</sub>                | 40    | ---  | ---  | ns   | Pins RS, R/W, E |
| ADDRESS HOLD TIME      | t <sub>HD1</sub>                | 10    | ---  | ---  | ns   | Pins RS, R/W, E |
| DATA SETUP TIME        | t <sub>SP2</sub>                | 80    | ---  | ---  | ns   | Pins: DB0 - DB7 |
| DATA HOLD TIME         | t <sub>HD2</sub>                | 10    | ---  | ---  | ns   | Pins: DB0 - DB7 |

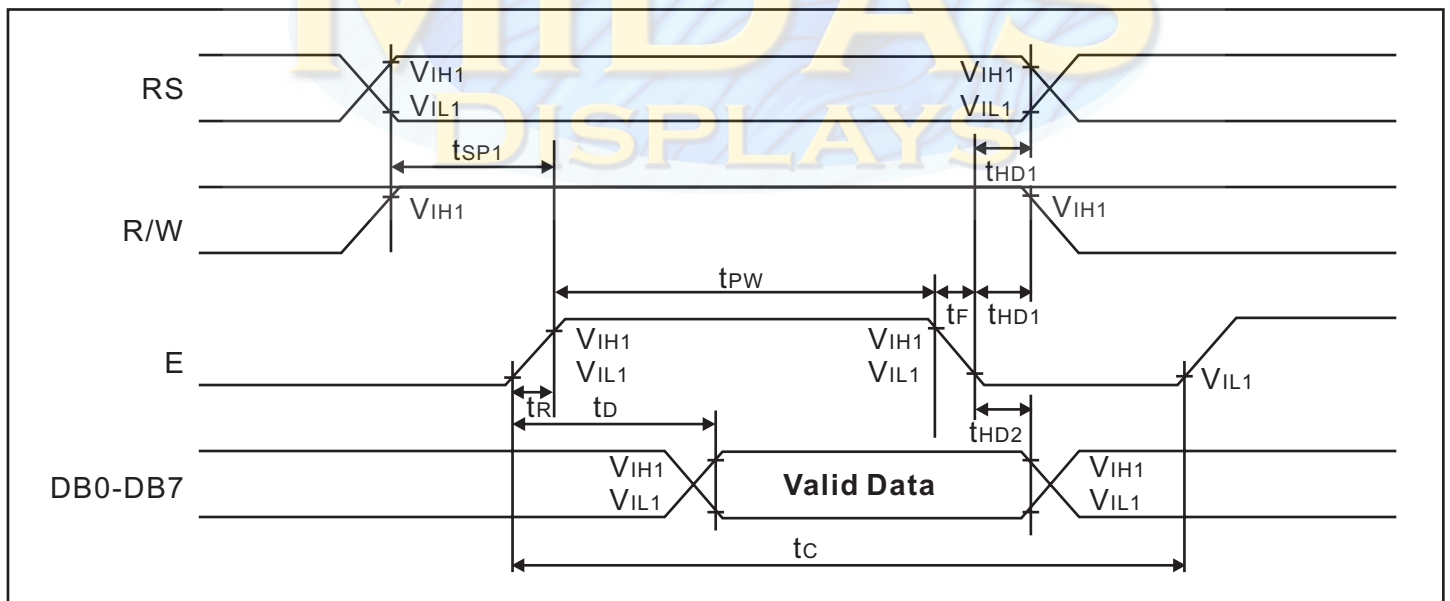
Read mode

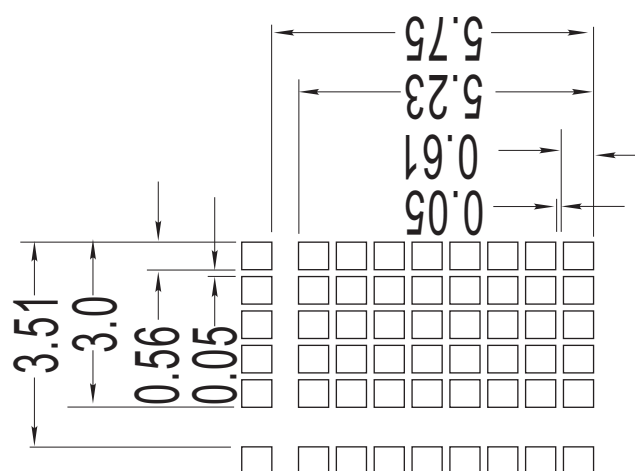
| CHARACTERISTICS        | SYMBOL                          | LIMIT |      |      | UNIT | TEST CONDITION  |
|------------------------|---------------------------------|-------|------|------|------|-----------------|
|                        |                                 | MIN.  | TYP. | MAX. |      |                 |
| ENABLE CYCLE TIME      | t <sub>c</sub>                  | 500   | ---  | ---  | ns   | Pin E           |
| ENABLE PULSE WIDTH     | t <sub>PW</sub>                 | 230   | ---  | ---  | ns   | Pin E           |
| ENABLE RISE/ FALL TIME | t <sub>R</sub> , t <sub>F</sub> | ---   | ---  | 20   | ns   | Pin E           |
| ADDRESS SETUP TIME     | t <sub>SP1</sub>                | 40    | ---  | ---  | ns   | Pins RS, R/W, E |
| ADDRESS HOLD TIME      | t <sub>HD1</sub>                | 10    | ---  | ---  | ns   | Pins RS, R/W, E |
| DATA OUTPUT DELAY TIME | t <sub>D</sub>                  | ---   | ---  | 120  | ns   | Pins: DB0 - DB7 |
| DATA HOLD TIME         | t <sub>HD2</sub>                | 5     | ---  | ---  | ns   | Pins: DB0 - DB7 |

## 6.3.1 WRITE MODE TIMING DIAGRAM



## 6.3.2 READ MODE TIMING DIAGRAM

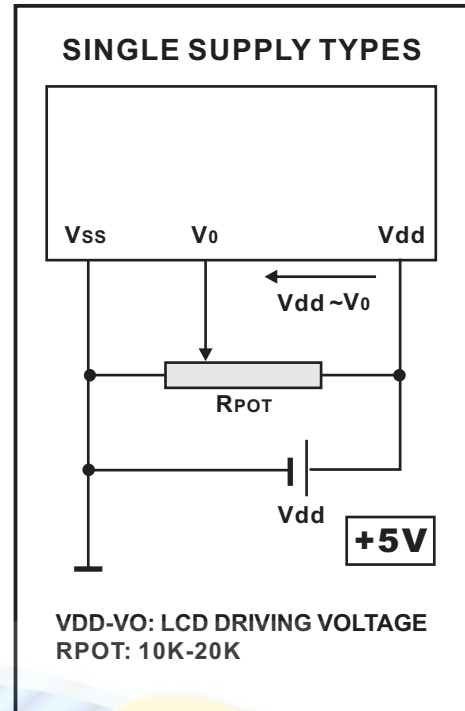




## 8. PIN ASSIGNMENT

| PIN  | SYMBOL    | FUNCTION                     |
|------|-----------|------------------------------|
| 1    | Vss       | GND                          |
| 2    | Vdd       | Power supply for LCM (+5.0V) |
| 3    | V0        | Contrast Adjust              |
| 4    | RS        | Register Select Signal       |
| 5    | R/W       | Data Read / Write            |
| 6    | E         | Enable Signal                |
| 7-14 | DB0 - DB7 | Data bus line                |
| 15   | LED+      | Power supply for BKL (+5.0V) |
| 16   | LED-      | Power supply for BKL (0V)    |

## 9. POWER SUPPLY



## 10. REFLECTOR OF SCREEN AND DDRAM ADDRESS

|                  |      |      |      |      |      |      |     |     |     |      |
|------------------|------|------|------|------|------|------|-----|-----|-----|------|
| Display position | 1-1  | 1-2  | 1-3  | 1-4  | 1-5  | 1-6  | 1-7 | 1-8 | 1-9 | 1-10 |
| DDRAM address    | 00   | 01   | 02   | 03   | 04   | 05   | 06  | 07  | 08  | 09   |
| Display position | 1-11 | 1-12 | 1-13 | 1-14 | 1-15 | 1-16 |     |     |     |      |
| DDRAM address    | 0A   | 0B   | 0C   | 0D   | 0E   | 0F   | 10  | 11  | 12  | 13   |
| Display position |      |      |      |      |      |      |     |     |     |      |
| DDRAM address    | 14   | 15   | 16   | 17   | 18   | 19   | 1A  | 1B  | 1C  | 1D   |
| Display position |      |      |      |      |      |      |     |     |     |      |
| DDRAM address    | 1E   | 1F   | 20   | 21   | 22   | 23   | 24  | 25  | 26  | 27   |
| Display position | 2-1  | 2-2  | 2-3  | 2-4  | 2-5  | 2-6  | 2-7 | 2-8 | 2-9 | 2-10 |
| DDRAM address    | 40   | 41   | 42   | 43   | 44   | 45   | 46  | 47  | 48  | 49   |
| Display position | 2-11 | 2-12 | 2-13 | 2-14 | 2-15 | 2-16 |     |     |     |      |
| DDRAM address    | 4A   | 4B   | 4C   | 4D   | 4E   | 4F   | 50  | 51  | 52  | 53   |
| Display position |      |      |      |      |      |      |     |     |     |      |
| DDRAM address    | 54   | 55   | 56   | 57   | 58   | 59   | 5A  | 5B  | 5C  | 5D   |
| Display position |      |      |      |      |      |      |     |     |     |      |
| DDRAM address    | 5E   | 5F   | 60   | 61   | 62   | 63   | 64  | 65  | 66  | 67   |

1-1 means first character of line 1 on screen

|  |                      |                   |             |              |
|--|----------------------|-------------------|-------------|--------------|
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**11. 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 20H to DDRAM 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                                                          | 38μs                         |
| 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                                                                      | 38μs                         |
| 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 DDRAM data                                | 38μs                         |
| Function Set               | 0                | 0   | 0   | 0   | 1   | DL  | N   | F   | -   | -   | Set interface data length(DL:8bit/4bit), number of display line (N:2line/1line) and,display font type F:5X11dots / 5X8dots     | 38μs                         |
| Set CGRAM Address          | 0                | 0   | 0   | 1   | AC5 | AC4 | AC3 | AC2 | AC1 | AC0 | Set CGRAM address in address counter                                                                                           | 38μs                         |
| Set DDRAM Address          | 0                | 0   | 1   | AC6 | AC5 | AC4 | AC3 | AC2 | AC1 | AC0 | Set DDRAM address in address counter                                                                                           | 38μs                         |
| 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<br>The contents of address counter can also be read        | 0 μs                         |
| Write Data to RAM          | 1                | 0   | D7  | D6  | D5  | D4  | D3  | D2  | D1  | D0  | Write data into internal RAM (DDRAM/CGRAM)                                                                                     | 38μs                         |
| Read data from RAM         | 1                | 1   | D7  | D6  | D5  | D4  | D3  | D2  | D1  | D0  | Read data from internal RAM (DDRAM/CGRAM)                                                                                      | 38μs                         |

|  |                      |                   |             |              |
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## 12. INSTRUCTION DESCRIPTION

### A. Clear Display

| RS | R/W | DB7 | DB6 | DB5 | DB4 | DB3 | DB2 | DB1 | DB0 |
|----|-----|-----|-----|-----|-----|-----|-----|-----|-----|
| 0  | 0   | 0   | 0   | 0   | 0   | 0   | 0   | 0   | 1   |

Clear all the display data by writing 20H (space code) to all DDRAM address, and set DDRAM address to 00H into AC (address counter).

Return cursor to the original status, namely, bring the cursor to the left edge on the first line of the display.

Make the entry mode increment ( I/D = HIGH )

### B. Return Home

| RS | R/W | DB7 | DB6 | DB5 | DB4 | DB3 | DB2 | DB1 | DB0 |
|----|-----|-----|-----|-----|-----|-----|-----|-----|-----|
| 0  | 0   | 0   | 0   | 0   | 0   | 0   | 0   | 1   | -   |

Set DDRAM address to 00H into the address counter.

Return cursor to its original site and return display to its original status, if shifted.

Contents of DDRAM does not change.

### C. Entry Mode Set

| RS | R/W | DB7 | DB6 | DB5 | DB4 | DB3 | DB2 | DB1 | DB0 |
|----|-----|-----|-----|-----|-----|-----|-----|-----|-----|
| 0  | 0   | 0   | 0   | 0   | 0   | 0   | 1   | I/D | SH  |

Set the moving direction of cursor and display.

**I/D: Increment /decrement of DDRAM address(cursor or blink)**

I/D=High, cursor/blink moves to right and DDRAM address is increased by 1.

I/D=low, cursor/blink moves to left and DDRAM address is decreased by 1.

\*CGRAM operates the same way as DDRAM, when reading from or writing to CGRAM.

**SH: Shift of entire display**

When DDRAM read (CGRAM read/write) operation or SH=Low, shifting of entire display is not performed. if SH=High, and DDRAM write operation, shift of entire display is performed according to I/D value (I/D=High, shift left, I/D=Low, shift right).

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#### D. Display ON/OFF Control

| RS | R/W | DB7 | DB6 | DB5 | DB4 | DB3 | DB2 | DB1 | DB0 |
|----|-----|-----|-----|-----|-----|-----|-----|-----|-----|
| 0  | 0   | 0   | 0   | 0   | 0   | 1   | D   | C   | B   |

##### D:Display ON/OFF control bit

When D=High, entire display is turned on.

When D=Low, display is turned off, but display data remains in DDRAM.

##### C:Cursor ON/OFF control bit

When C=High, cursor is turned on.

When C=Low, cursor is disappeared in current display ,but I/D register preserves its data.

##### B:Cursor Blink ON/OFF control bit

When B=High, cursor blink is on, which performs alternately between all the High data and display characters at the cursor position.

When B=Low ,blink is off.

#### E. Cursor or Display Shift

| RS | R/W | DB7 | DB6 | DB5 | DB4 | DB3 | DB2 | DB1 | DB0 |
|----|-----|-----|-----|-----|-----|-----|-----|-----|-----|
| 0  | 0   | 0   | 0   | 0   | 1   | S/C | R/L | -   | -   |

Shifting of right/left cursor position or display without writing or reading of display data.

This instruction is used to correct or search display data.

During 2-line mode display, cursor moves to the 2<sup>nd</sup> line after the 40<sup>th</sup> digit of the 1<sup>st</sup> line.

Note that display shift is performed simultaneously in all the lines.

When displayed data is shifted repeatedly, each line is shifted individually.

When display shift is performed, the contents of the address counter are not changed.

| S/C | R/L | Operation                                                                |
|-----|-----|--------------------------------------------------------------------------|
| 0   | 0   | Shift cursor to the left, AC is decreased by 1                           |
| 0   | 1   | Shift cursor to the right, AC is increased by 1                          |
| 1   | 0   | Shift all the display to the left,cursor moves according to the display  |
| 1   | 1   | Shift all the display to the right,cursor moves according to the display |

|  |                      |                   |                   |
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## F. Function set

| RS | R/W | DB7 | DB6 | DB5 | DB4 | DB3 | DB2 | DB1 | DB0 |
|----|-----|-----|-----|-----|-----|-----|-----|-----|-----|
| 0  | 0   | 0   | 0   | 1   | DL  | N   | F   | -   | -   |

### DL:Interface data length control bit

When DL=High, it means 8-bit bus mode with MPU.

When DL=Low, it means 4-bit bus mode with MPU.

When 4-bit bus mode, it needs to transfer 4-bit data twice.

### N:Display line number control bit

When N=Low, 1-line display mode is set.

When N=High, 2-line display mode is set.

### F:Display font type control bit

When F=Low, 5x8 dots format display mode is set.

When F=High, 5x11 dots format display mode.

## G. Set CGRAM Address

| RS | R/W | DB7 | DB6 | DB5 | DB4 | DB3 | DB2 | DB1 | DB0 |
|----|-----|-----|-----|-----|-----|-----|-----|-----|-----|
| 0  | 0   | 0   | 1   | AC5 | AC4 | AC3 | AC2 | AC1 | AC0 |

Set CGRAM address to AC.

This instruction makes CGRAM data available from MPU.

## H. Set DDRAM Address

| RS | R/W | DB7 | DB6 | DB5 | DB4 | DB3 | DB2 | DB1 | DB0 |
|----|-----|-----|-----|-----|-----|-----|-----|-----|-----|
| 0  | 0   | 1   | AC6 | AC5 | AC4 | AC3 | AC2 | AC1 | AC0 |

Set DDRAM address to AC.

This instruction makes DDRAM data available from MPU.

When 1-line display mode (N=Low), DDRAM address is from 00H to 4FH

In 2-line display mode(N=High),DDRAM address in the 1<sup>st</sup> line is from 00H to 27H and DDRAM address in the 2<sup>nd</sup> line is from 40H to 67H

|  |                      |                   |             |              |
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### I. Read Busy Flag & Address

| RS | R/W | DB7 | DB6 | DB5 | DB4 | DB3 | DB2 | DB1 | DB0 |
|----|-----|-----|-----|-----|-----|-----|-----|-----|-----|
| 0  | 1   | BF  | AC6 | AC5 | AC4 | AC3 | AC2 | AC1 | AC0 |

This instruction shows whether IC is in internal operation or not .

If BF is High, internal operation is in progress and shall wait until BF is to be Low, which by then the next instruction can be performed. In this instruction you and also read the value of the address counter.

### J. Write data to RAM

| RS | R/W | DB7 | DB6 | DB5 | DB4 | DB3 | DB2 | DB1 | DB0 |
|----|-----|-----|-----|-----|-----|-----|-----|-----|-----|
| 1  | 0   | D7  | D6  | D5  | D4  | D3  | D2  | D1  | D0  |

Write binary 8-bit data to DDRAM/CGRAM.

The selection of RAM from DDRAM, and CGRAM, is set by the previous address set instruction (DDRAM address set, CGRAM address set).

RAM set instruction can also determine the AC direction to RAM.

After write operation, the address is automatically increased / decreased by 1, according to the entry mode.

### K. Read data from RAM

| RS | R/W | DB7 | DB6 | DB5 | DB4 | DB3 | DB2 | DB1 | DB0 |
|----|-----|-----|-----|-----|-----|-----|-----|-----|-----|
| 1  | 1   | D7  | D6  | D5  | D4  | D3  | D2  | D1  | D0  |

Read binary 8-bit data from DDRAM/CGRAM.

The selection of RAM is set by the previous address set instruction. If the address set instruction of RAM is not performed before this instruction, the data that has been read first is invalid, as the direction of AC is not yet determined. If RAM data is read several times without RAM address instructions set before read operation, the correct RAM data can be obtained from the second. But the first data would be incorrect, as there is no time margin to transfer RAM data.

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In case of DDRAM read operation, cursor shift instruction plays the same role as DDRAM address set instruction, it also transfers RAM data to output data register.

After read operation, address counter is automatically increased/decreased by 1 according to the entry mode.

After CGRAM read operation, display shift may not be executed correctly.

Note: In case of RAM write operation, AC is increased/decreased by 1 as in read operation.

At this time, AC indicates the next address position, but only the previous data can be read by the read instruction.

### 13. RELATIONSHIP BETWEEN CHARACTER CODE AND CGRAM

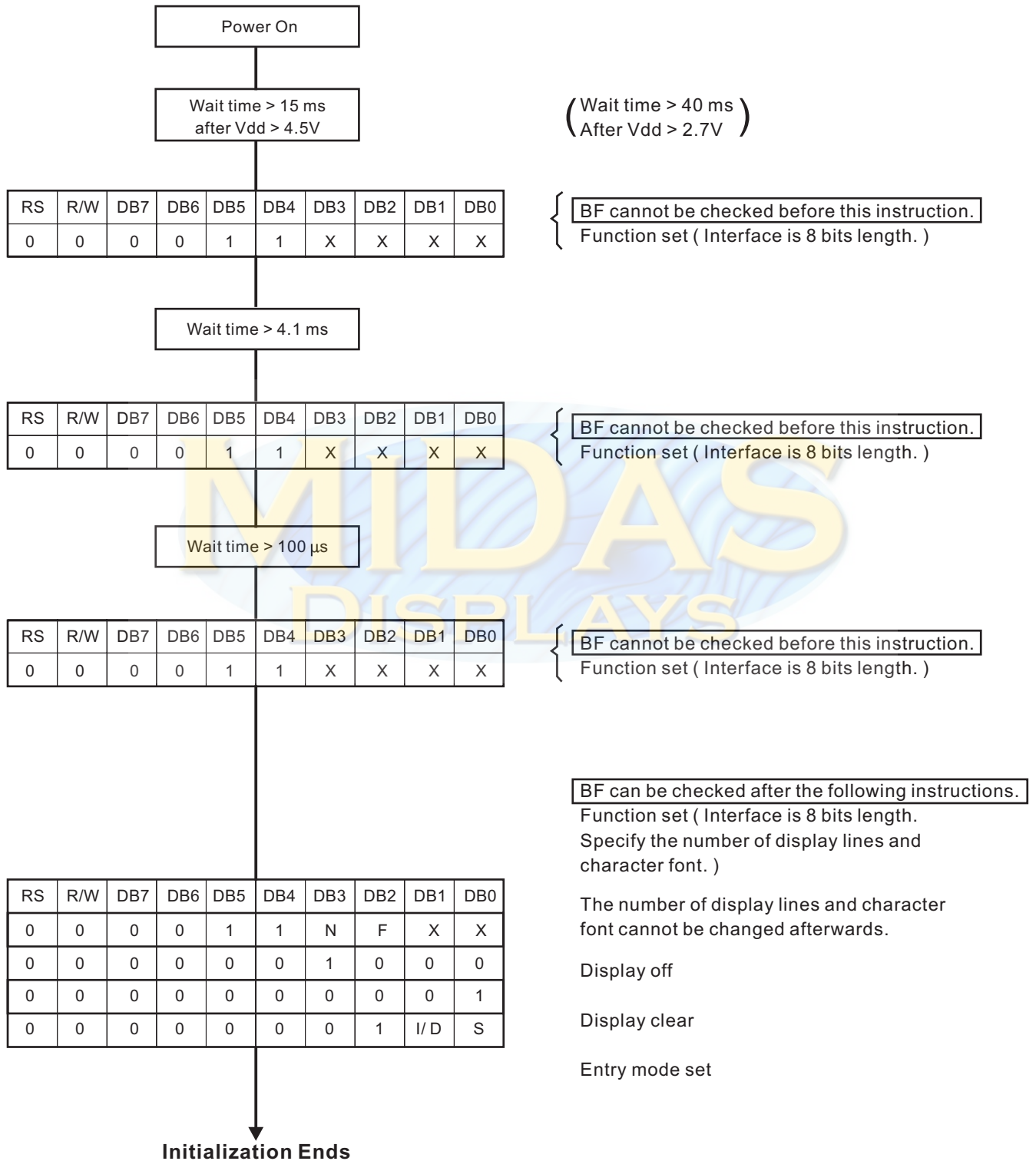
| Character code          | CGRAM Address     | CGRAM Data              | Pattern number |
|-------------------------|-------------------|-------------------------|----------------|
| D7 D6 D5 D4 D3 D2 D1 D0 | A5 A4 A3 A2 A1 A0 | P7 P6 P5 P4 P3 P2 P1 P0 |                |
| 0 0 0 0 x 0 0 0         | 0 0 0 0 0 0       | x x x 0 1 1 1 0         | pattern 1      |
|                         | 0 0 1             | x x x 1 0 0 0 1         |                |
|                         | 0 1 0             | x x x 1 0 0 0 1         |                |
|                         | 0 1 1             | x x x 1 1 1 1 1         |                |
|                         | 1 0 0             | x x x 1 0 0 0 1         |                |
|                         | 1 0 1             | x x x 1 0 0 0 1         |                |
|                         | 1 1 0             | x x x 1 0 0 0 1         |                |
|                         | 1 1 1             | x x x 0 0 0 0 0         |                |
|                         |                   |                         |                |
| 0 0 0 0 x 1 1 1         | 0 0 0 0 0 0       | x x x 1 0 0 0 1         | pattern8       |
|                         | 0 0 1             | x x x 1 0 0 0 1         |                |
|                         | 0 1 0             | x x x 1 0 0 0 1         |                |
|                         | 0 1 1             | x x x 1 1 1 1 1         |                |
|                         | 1 0 0             | x x x 1 0 0 0 1         |                |
|                         | 1 0 1             | x x x 1 0 0 0 1         |                |
|                         | 1 1 0             | x x x 1 0 0 0 1         |                |
|                         | 1 1 1             | x x x 0 0 0 0 0         |                |

### 14. DISPLAY DATA RAM(DDRAM)

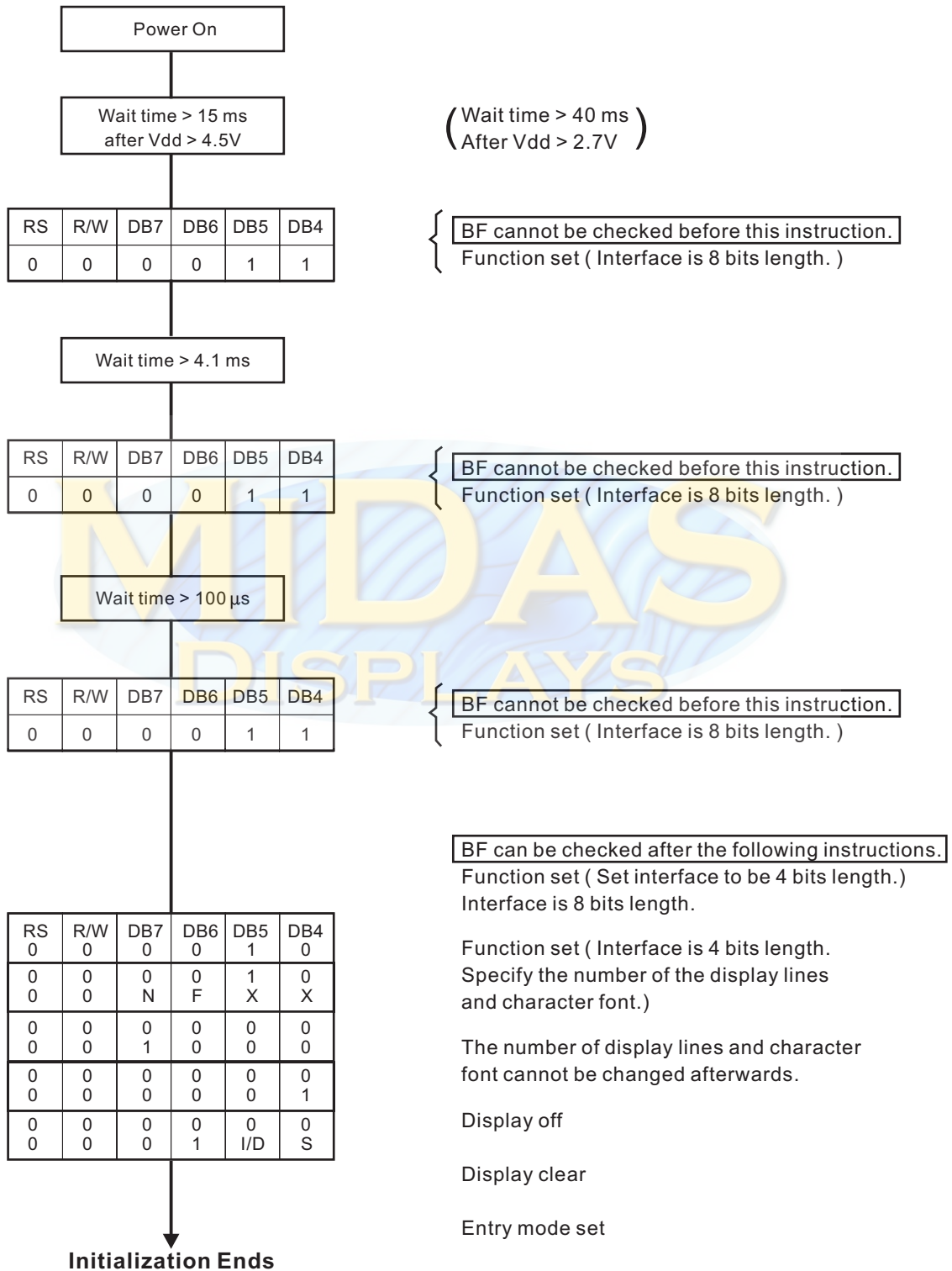
DDRAM stores display data of maximum 80x8 bits(80 characters).

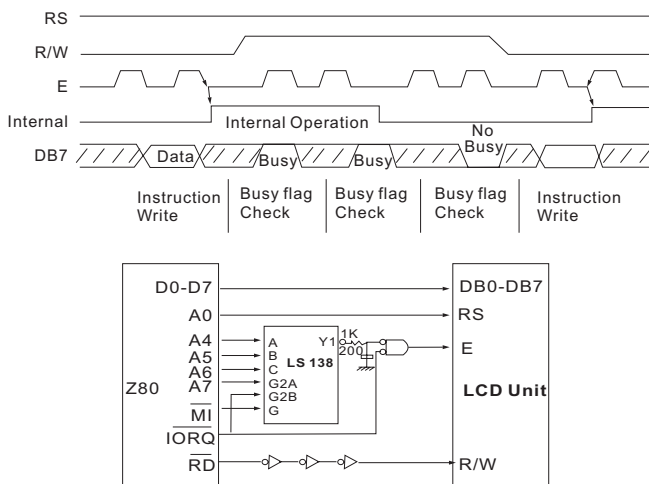
DDRAM address is set in the address counter(AC) as a hexadecimal number

| MSB |     |     |     | LSB |     |     |  |
|-----|-----|-----|-----|-----|-----|-----|--|
| AC6 | AC5 | AC4 | AC3 | AC2 | AC1 | AC0 |  |

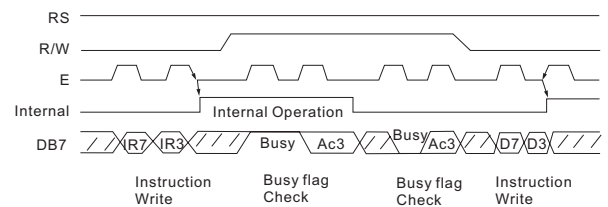
**15. INITIALIZATION****15.1 8-bit interface mode (Condition: fosc = 270KHZ)**

## 15.2 4-bit interface mode (Condition: fosc = 270KHZ)

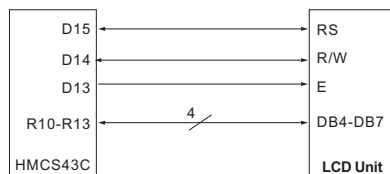


**16.INTERFACE TO MPU****INTERFACE TO 8-BIT MPU****If Interface Data Is 8-bits Long**

Data transfer is made through all 8 bus lines from DB0 to DB7

**INTERFACE TO 4-BIT MPU**

Note: IR7,IR3: Instruction 7th bit,3rd bit  
Ac3: Address Counter 3rd bit

**If Interface Data Is 4-bit Long**

Data transfer is accomplished through 4 bus lines from DB4 to DB7.(while the rest of 4 bus lines from DB0 to DB3 are not used.)  
Data transfer is completed when 4-bits of data is transferred twice.(upper 4-bits of data, then lower 4-bits of data.)

**Features**

- Interface to an 8-bit or 4-bit MPU is available.
- 192 types of alphanumeric, symbols and special characters can be displayed with the built - in character generator (ROM).
- Other preferred characters can be displayed by character generator (RAM).
- Various instructions may be programmed.
  - Clear display
  - Cursor at home
  - On/Off cursor
  - Blink character
  - Shift display
  - Shift cursor
  - Read/Write display data .etc.
- Compact and light weight design which can easily be integrated into end products.
- Single power supply +5V drive (except for extended temperature type).
- Low power consumption.

# BOOKBINDING AREA

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## 17. STANDARD FONT MAP

| Upper<br>4bit<br>Lower<br>4bit | LLLL             | LLH | LLHL | LLHH | LHLL | LHLH | LHHL | LHHH | HLLL | HLLH | HLHL | HLHH | HHLL | HHLH | HHHL | HHHH |
|--------------------------------|------------------|-----|------|------|------|------|------|------|------|------|------|------|------|------|------|------|
| LLLL                           | CG<br>RAM<br>(1) |     |      |      |      |      |      |      |      |      |      |      |      |      |      |      |
| LLH                            | (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)              |     |      |      |      |      |      |      |      |      |      |      |      |      |      |      |

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## 18. PACKING DETAIL

| WITH LED BKL                | WITHOUT LED BKL             |
|-----------------------------|-----------------------------|
| 45 PCS/BOX                  | 45 PCS/BOX                  |
| 10 BOXES/CARTON             | 10 BOXES/CARTON             |
| 450 PCS/CARTON              | 450 PCS/CARTON              |
| 20.00 KGS/CTN(G.W.)         | 18.00 KGS/CTN(G.W.)         |
| 0.07 M <sup>3</sup> /CARTON | 0.07 M <sup>3</sup> /CARTON |

### NOTE

1. The weight is estimated for reference only.
2. Packing detail may be changed without notice.

