| DOC. | DATASHEET STATEMENT |
|------|---------------------|

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2. The ISO9001 logo used in this document is authorized by SGS (www.sgs.com). Midas had already successfully passed the strict and professional ISO9001:2000 Quality Management System Certification and got the certificate (No.: CN07/00404)

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4. As the difference in test standard and test conditions, also Midas insufficient familiarity with the actual LCD using environment, all the referred information in this DATASHEET (including the icons) only have two functions:
4.1: providing quick reference when you are judging whether or not the product meets your requirements.
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5. The sequence of the icons is random and doesn't indicate the importance grade.

6. Icons explanation

Midas 2006 version logo.Midas is an integrated manufacturer of flat panel display (FPD). Midas supplies TN, HTN, STN, FSTN monochrome LCD panel; COB, COG, TAB LCD module; and all kinds of LED backlight.

**FAST RESPONSE TIME**
This icon on the cover indicates the product is with high response speed; Otherwise not.

**PROTECTION CIRCUIT**
This icon on the cover indicates the product is with protection circuit; Otherwise not.

**HIGH CONTRAST**
This icon on the cover indicates the product is with high contrast; Otherwise not.

**LONG LIFE VERSION**
This icon on the cover indicates the product is long life version (over 9K hours guaranteed); Otherwise not.

**WIDE VIEWING SCOPE**
This icon on the cover indicates the product is with wide viewing scope; Otherwise not.

**Anti UV VERSION**
This icon on the cover indicates the product is against UV line.  Otherwise not.

**RoHS COMPLIANCE**
This icon on the cover indicates the product meets ROHS requirements; Otherwise not.
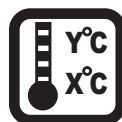
**OPERATION TEMPERATURE RANGE**
This icon on the cover indicates the operating temperature range (X-Y).

**3TIMEs 100% QC EXAMINATION**
This icon on the cover indicates the product has passed Midas thrice 100% QC. Otherwise not.

**TWICE SELECTION OF LED MATERIALS**
This icon on the cover indicates the LED had passed Midas twice strict selection which promises the product's identical color and brightness; Otherwise not.

**VIcm = 3.0V**
This icon on the cover indicates the product can work at 3.0V exactly; otherwise not.

**N SERIES TECHNOLOGY (2008 developed)**
New structure, new craft, new technology and new materials inside both LCD module and LCD panel to improve the "RainBow"

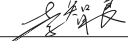| STANDARD DOC. | REVISION RECORD | PAGE | 1/20 |
|---|---|---|---|

| NO. | DATE | DESCRIPTION | ITEM | PAGE | APPROVED |
|---|---|---|---|---|---|
| 1 | 2011.06 | INITIAL ISSUED | ALL | ALL | |

# Midas LCD Part Number System

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

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

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 of PCB | Common (via pins 1 and 2) | Array or Edge Lit |
|---|---|---|---|
| **Blank** | 9.5mm / not applicable | Common | Array |
| **2** | 8.9 mm | Common | Array |
| **3** | 7.8 mm | Separate | Array |
| **4** | 7.8 mm | Common | Array |
| **5** | 9.5 mm | Separate | Array |
| **6** | 7 mm | Common | Array |
| **7** | 7 mm | Separate | Array |
| **8** | 6.4 mm | Common | Edge |
| **9** | 6.4 mm | Separate | Edge |
| **A** | 5.5 mm | Common | Edge |
| **B** | 5.5 mm | Separate | Edge |

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:** I²C

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

| | STANDARD DOC. | CONTENTS | PAGE | 3/20 |
|---|---|---|---|---|

# 1. GENERAL SPECIFICATIONS

| ITEM | NOMINAL DIMENSIONS / AVAILABLE OPTIONS |
|---|---|
| DISPLAY FORMAT | 16 Characters by 2 Lines |
| LCD PANEL OPTIONS | STN (Yellow-green color) |
| POLARIZER OPTIONS | Positive, Reflective |
| BACKLIGHT OPTIONS | No Backlight |
| VIEWING ANGLE OPTIONS | 6:00 ( Bottom ) |
| TEMPERATURE RANGE OPTIONS | Wide temp. range ( -20$^\circ$C ~ 70$^\circ$C ) |
| CONTROLLER IC | SUNPLUS |
| DISPLAY DUTY | 1/16 |
| DRIVING BIAS | 1/5 |

# 2. MECHANICAL SPECIFICATIONS

| OVERALL SIZE | No backlight version : | | 85.0 x 36.0 x max 9.5 | | mm |
|---|---|---|---|---|---|
| VIEWING AREA | 64.5W x 16.4H | mm | HOLE-HOLE | 80.0W x 31.0H | mm |
| CHARACTER SIZE | 3.00W x 5.23H | mm | CHARACTER PITCH | 0.51W x 0.52H | mm |
| DOT SIZE | 0.56W x 0.61H | mm | DOT PITCH | 0.05W x 0.05H | mm |

# 3. ABSOLUTE MAXIMUM RATINGS

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

# 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$^\circ$C | 4.30 | ——— | 4.85 | V |
| | | 0$^\circ$C | 4.25 | ——— | 4.75 | |
| | | 25$^\circ$C | 4.20 | 4.50 | 4.70 | |
| | | 50$^\circ$C | 4.10 | ——— | 4.60 | |
| | | 70$^\circ$C | 3.85 | ——— | 4.50 | |

* The above data are for reference only.

## 5. OPTICAL CHARACTERISTIC

### FOR TN TYPE LCD MODULE (T$_A$=25$^{\circ}$C, Vdd=5.0V ± 0.25V)

| ITEM | SYMBOL | CONDITION | MIN | TYP | MAX | UNIT |
|---|---|---|---|---|---|---|
| VIEWING ANGLE | $\Phi2 - \Phi1$ | 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$^{\circ}$C, Vdd=5.0V ± 0.25V)

| ITEM | SYMBOL | CONDITION | MIN | TYP | MAX | UNIT |
|---|---|---|---|---|---|---|
| VIEWING ANGLE | $\Phi2 - \Phi1$ | 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 $\Phi1$ & $\Phi2$



### DEFINITION OF CONTRAST RATIO K(=B$_2$/B$_1$)



### DEFINITION OF OPTICAL RESPONSE TIME T$_R$ & T$_F$
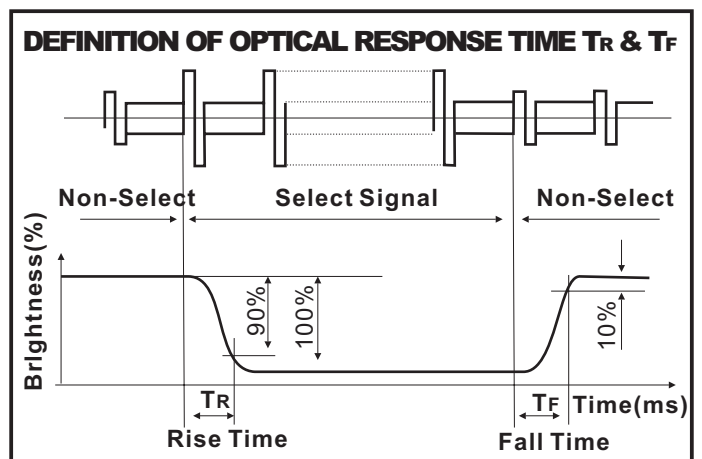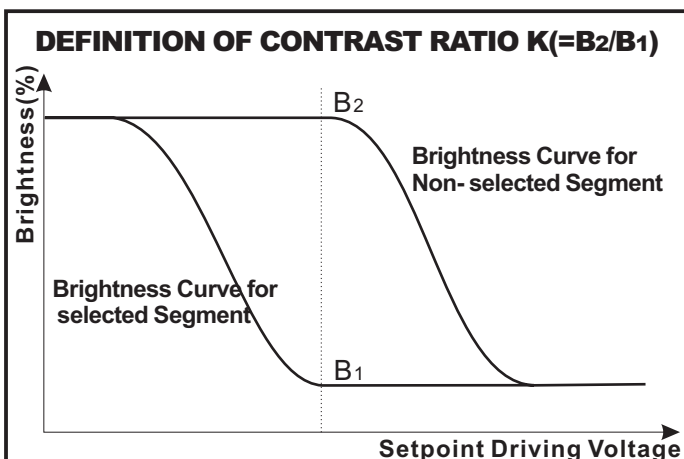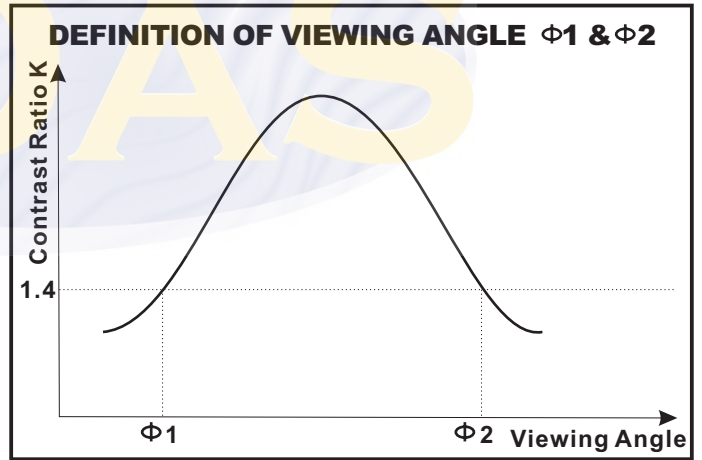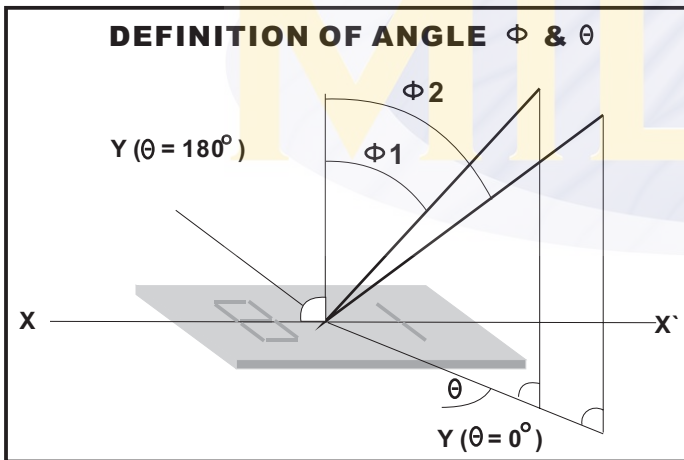
| | PRODUCT SPEC. | MODE NO. | PAGE | 6/20 |
|---|---|---|---|---|

# 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 | $V_{IH1}$ | 2.2 | --- | Vdd | V | Pins ( E. RS. R/W. DB0 - DB7 ) |
| INPUT LOW VOLTAGE | $V_{IL1}$ | -0.3 | --- | 0.6 | V | |
| INPUT HIGH CURRENT | $I_{IH}$ | -2.0 | --- | 2.0 | μA | Pins ( RS. R/W. DB0 - DB7 ) Vdd = 5.0V |
| INPUT LOW CURRENT | $I_{IL}$ | -20 | -50 | -100 | μA | |
| OUTPUT HIGH VOLTAGE ( TTL ) | $V_{OH1}$ | 2.4 | --- | Vdd | V | $I_{OH} = - 0.1mA$ Pins: DB0 - DB7 |
| OUTPUT LOW VOLTAGE ( TTL ) | $V_{OL1}$ | --- | --- | 0.4 | V | $I_{OL} = 0.1mA$ 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 | $t_C$ | 500 | --- | --- | ns | Pin E |
| ENABLE PULSE WIDTH | $t_{PW}$ | 230 | --- | --- | ns | Pin E |
| ENABLE RISE/ FALL TIME | $t_R, t_F$ | --- | --- | 20 | ns | Pin E |
| ADDRESS SETUP TIME | $t_{SP1}$ | 40 | --- | --- | ns | Pins RS, R/W, E |
| ADDRESS HOLD TIME | $t_{HD1}$ | 10 | --- | --- | ns | Pins RS, R/W, E |
| DATA SETUP TIME | $t_{SP2}$ | 80 | --- | --- | ns | Pins: DB0 - DB7 |
| DATA HOLD TIME | $t_{HD2}$ | 10 | --- | --- | ns | Pins: DB0 - DB7 |

### Read mode

| CHARACTERISTICS | SYMBOL | LIMIT | | | UNIT | TEST CONDITION |
|---|---|---|---|---|---|---|
| | | MIN. | TYP. | MAX. | | |
| ENABLE CYCLE TIME | $t_C$ | 500 | --- | --- | ns | Pin E |
| ENABLE PULSE WIDTH | $t_{PW}$ | 230 | --- | --- | ns | Pin E |
| ENABLE RISE/ FALL TIME | $t_R, t_F$ | --- | --- | 20 | ns | Pin E |
| ADDRESS SETUP TIME | $t_{SP1}$ | 40 | --- | --- | ns | Pins RS, R/W, E |
| ADDRESS HOLD TIME | $t_{HD1}$ | 10 | --- | --- | ns | Pins RS, R/W, E |
| DATA OUTPUT DELAY TIME | $t_D$ | --- | --- | 120 | ns | Pins: DB0 - DB7 |
| DATA HOLD TIME | $t_{HD2}$ | 5 | --- | --- | ns | Pins: DB0 - DB7 |

## 6.3.1 WRITE MODE TIMING DIAGRAM
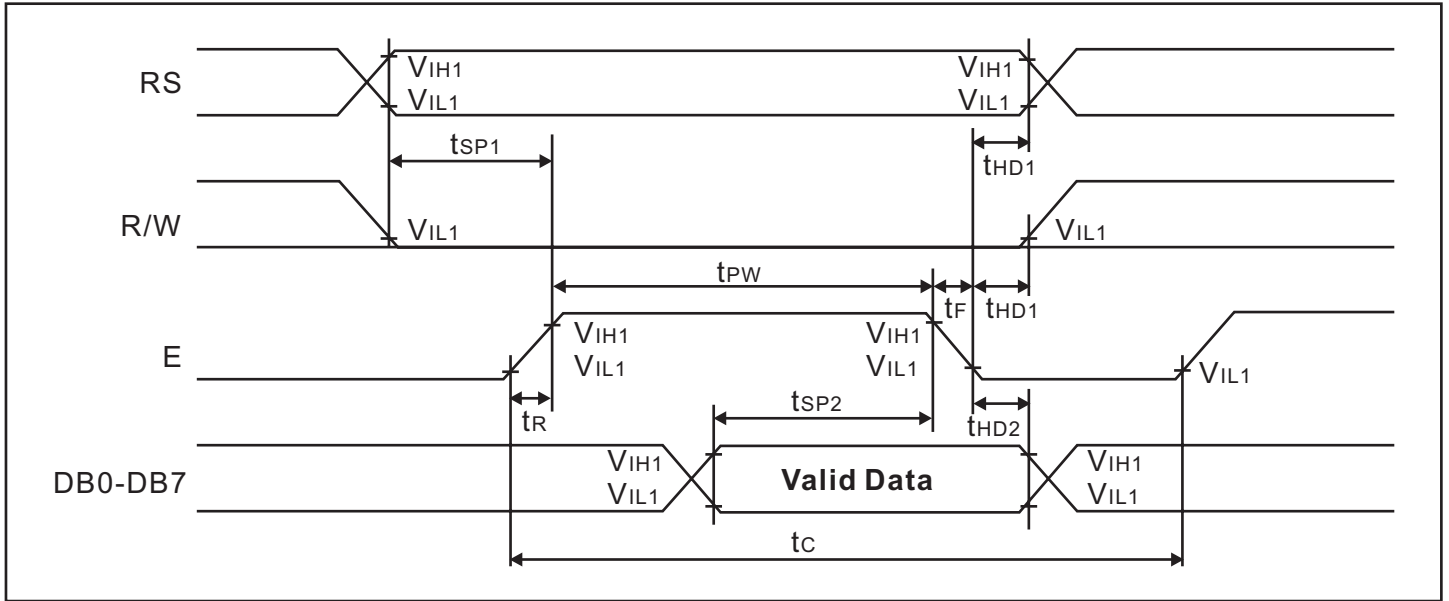


## 6.3.2 READ MODE TIMING DIAGRAM
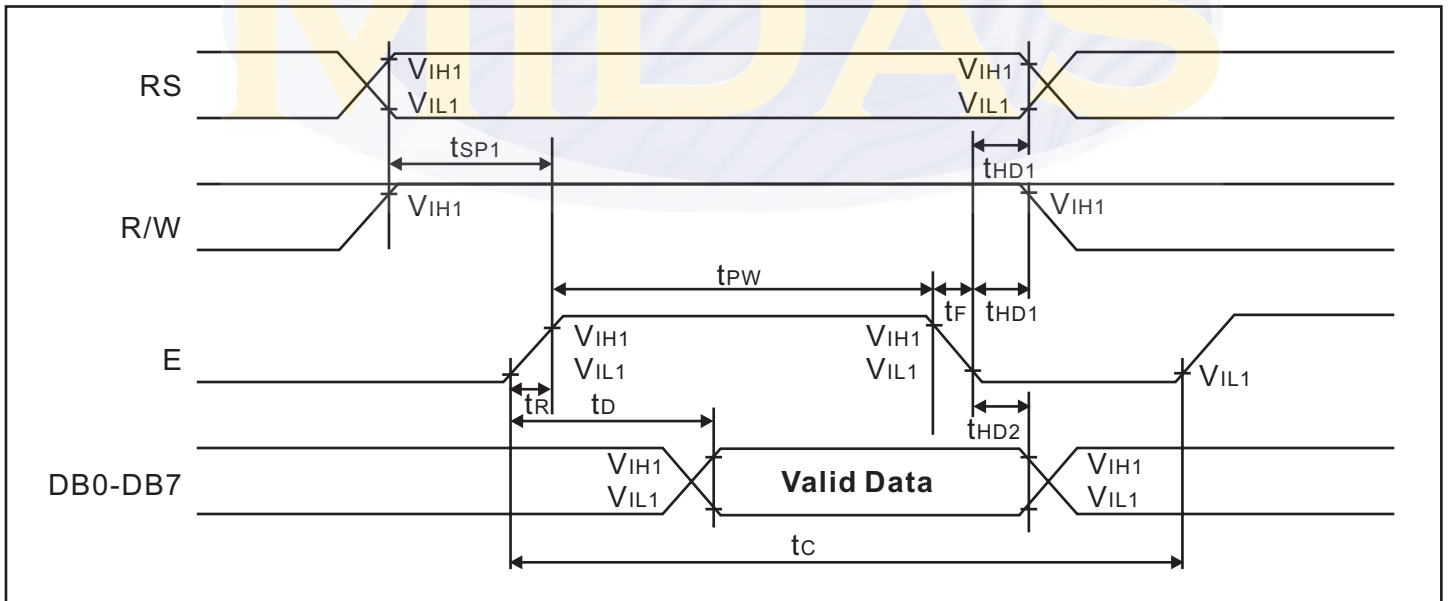
# 7. EXTERNAL DIMENSIONS



| ITEM | T1 | T2 | UNIT |
|---|---|---|---|
| EL or without backlight | 9.5 | 4.6 | mm |
| LED backlight | 13.5 | 8.6 | mm |
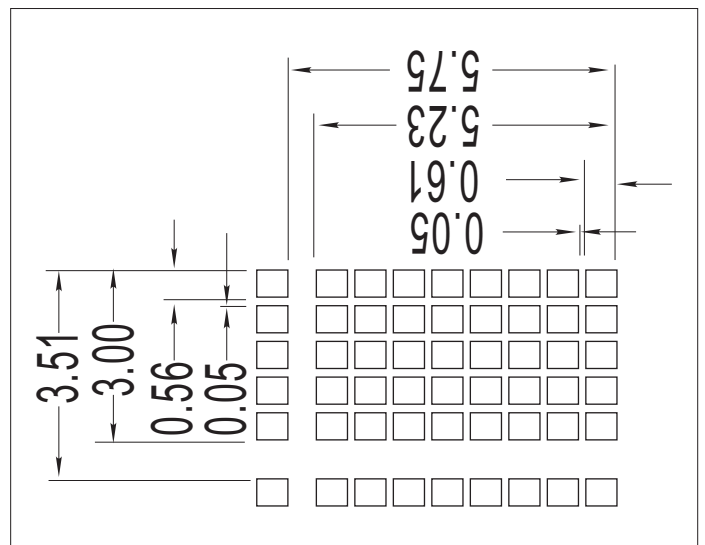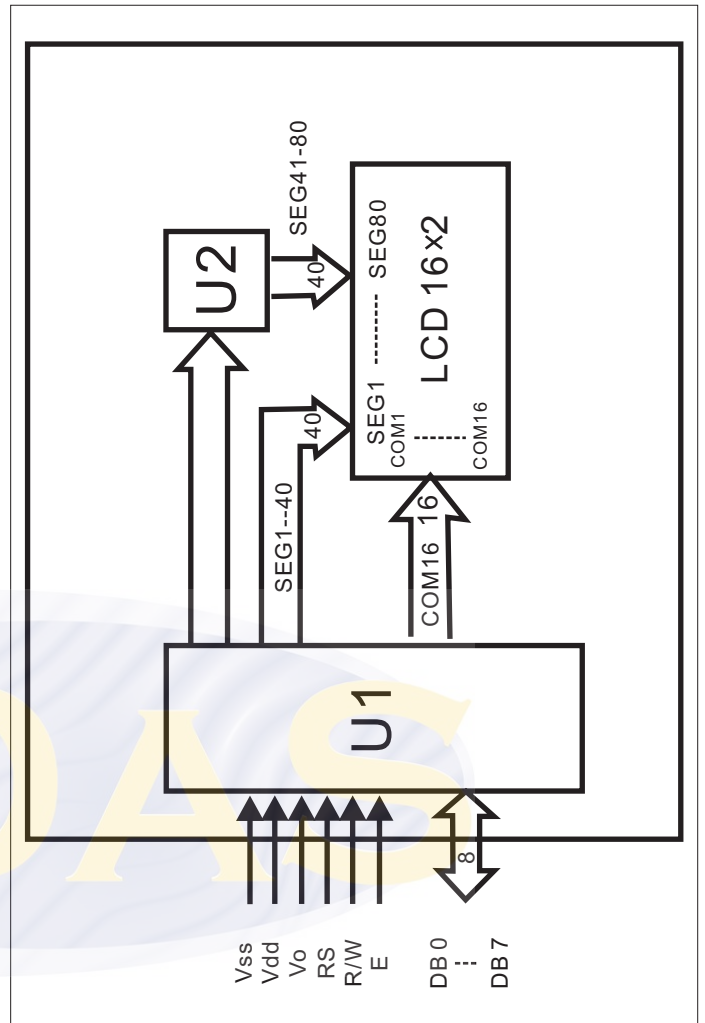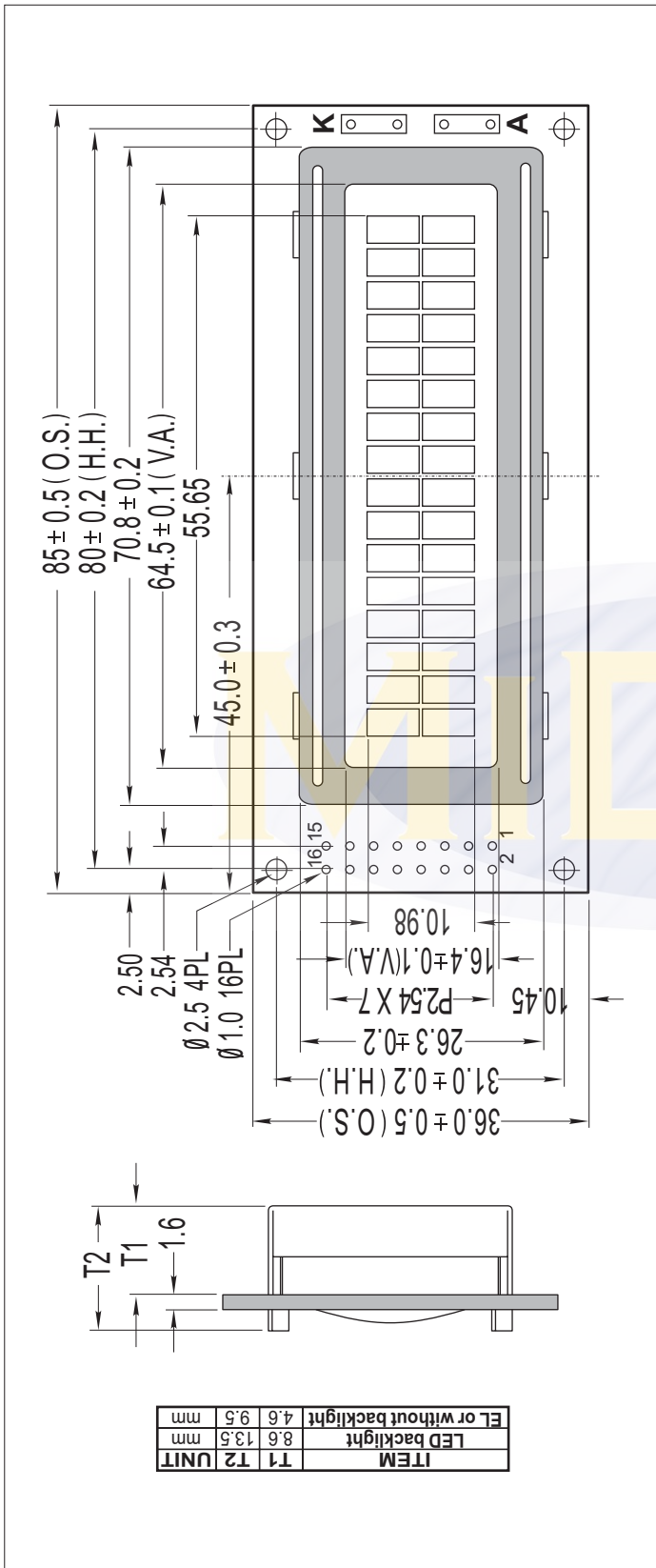
## 8.PIN ASSIGNMENT

| 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 | NC | No Connection |
| 16 | NC | No Connection |

## 9.POWER SUPPLY

**SINGLE SUPPLY TYPES**

Vss    V0    Vdd

Vdd ~V0

$R_{POT}$

Vdd

+5V

VDD-VO: LCD DRIVING VOLTAGE
RPOT: 10K-20K
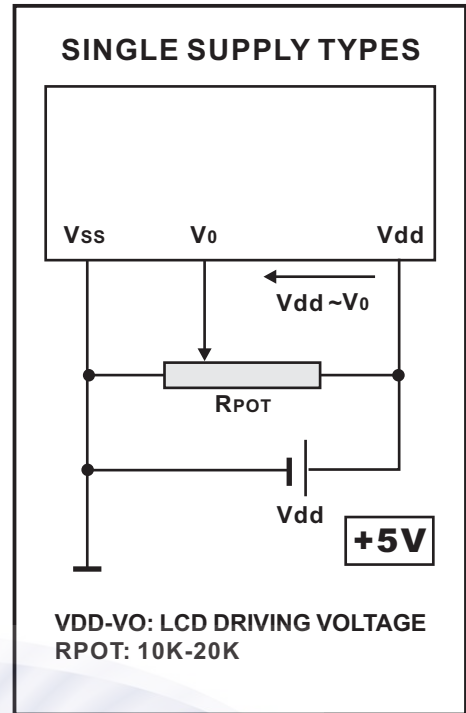
## 10. REFLECTOR OF SCREEN AND DDRAM ADDRESS

| 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

## 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 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 |

## 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).

## 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 $2^{nd}$ line after the $40^{th}$ digit of the $1^{st}$ 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 |

## 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 1st line is from 00H to 27H and DDRAM address in the 2nd line is from 40H to 67H

## 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 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.

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)

```
Power On
```

```
Wait time > 15 ms
after Vdd > 4.5V
```

$$\left( \begin{array}{l} \text{Wait time > 40 ms} \\ \text{After Vdd > 2.7V} \end{array} \right)$$

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

BF cannot be checked before this instruction.
Function set ( Interface is 8 bits length. )

```
Wait time > 4.1 ms
```

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

BF cannot be checked before this instruction.
Function set ( Interface is 8 bits length. )

```
Wait time > 100 µs
```

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

BF cannot be checked before this instruction.
Function set ( Interface is 8 bits length. )

BF can be checked after the following instructions.
Function set ( Interface is 8 bits length.
Specify the number of display lines and
character font. )

The number of display lines and character
font cannot be changed afterwards.

| RS | R/W | DB7 | DB6 | DB5 | DB4 | DB3 | DB2 | DB1 | DB0 |
|----|-----|-----|-----|-----|-----|-----|-----|-----|-----|
| 0 | 0 | 0 | 0 | 1 | 1 | N | F | X | X |
| 0 | 0 | 0 | 0 | 0 | 0 | 1 | 0 | 0 | 0 |
| 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 |
| 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | I/ D | S |

Display off

Display clear

Entry mode set

**Initialization Ends**

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

```
┌─────────────────┐
│    Power On      │
└─────────────────┘
         │
┌─────────────────┐
│ Wait time > 15 ms│        ( Wait time > 40 ms )
│ after Vdd > 4.5V │        ( After Vdd > 2.7V  )
└─────────────────┘
```

| RS | R/W | DB7 | DB6 | DB5 | DB4 |
|----|-----|-----|-----|-----|-----|
| 0  | 0   | 0   | 0   | 1   | 1   |

BF cannot be checked before this instruction.
Function set ( Interface is 8 bits length. )

Wait time > 4.1 ms

| RS | R/W | DB7 | DB6 | DB5 | DB4 |
|----|-----|-----|-----|-----|-----|
| 0  | 0   | 0   | 0   | 1   | 1   |

BF cannot be checked before this instruction.
Function set ( Interface is 8 bits length. )

Wait time > 100 μs

| RS | R/W | DB7 | DB6 | DB5 | DB4 |
|----|-----|-----|-----|-----|-----|
| 0  | 0   | 0   | 0   | 1   | 1   |

BF cannot be checked before this instruction.
Function set ( Interface is 8 bits length. )

BF can be checked after the following instructions.
Function set ( Set interface to be 4 bits length.)
Interface is 8 bits length.

| RS | R/W | DB7 | DB6 | DB5 | DB4 |
|----|-----|-----|-----|-----|-----|
| 0  | 0   | 0   | 0   | 1   | 0   |
| 0  | 0   | N   | F   | X   | X   |
| 0  | 0   | 0   | 0   | 0   | 0   |
| 0  | 0   | 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   | 1   | I/D | S   |

Function set ( Interface is 4 bits length.
Specify the number of the display lines
and character font.)

The number of display lines and character
font cannot be changed afterwards.

Display off

Display clear

Entry mode set

**Initialization Ends**

## 16.INTERFACE TO MPU

### INTERFACE TO 8-BIT MPU

RS
R/W
E
Internal — Internal Operation — No Busy
DB7 —— Data —— Busy —— Busy ——

Instruction Write | Busy flag Check | Busy flag Check | Busy flag Check | Instruction Write

D0-D7 → DB0-DB7
A0 → RS
A4
A5        A — Y1    1K 200
A6        B   LS 138          → E
A7        C
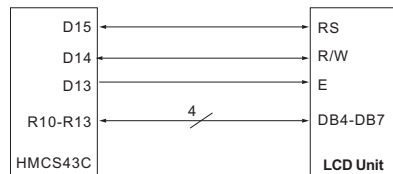Z80       G2A          **LCD Unit**
          G2B
MI        G
IORQ
RD → R/W

**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

RS
R/W
E
Internal — Internal Operation
DB7 — R7 IR3 — Busy Ac3 — Busy Ac3 — D7 D3 —

Instruction Write | Busy flag Check | Busy flag Check | Instruction Write

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

D15 → RS
D14 → R/W
D13 → E
R10-R13 —4— DB4-DB7
HMCS43C          **LCD Unit**

**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 toDB3 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

1. **Interface to an 8-bit or 4-bit MPU is available.**
2. **192 types of alphanumeric, symbols and special characters can be displayed with the built - in character generator (ROM).**
3. **Other preferred  characters can be displayed by character generator (RAM).**
4. **Various instructions may be programmed.**
   - **Clear display**
   - **Cursor at home**
   - **On/Off cursor**
   - **Blink character**
   - **Shift display**
   - **Shift cursor**
   - **Read/Write display data   .etc.**
5. **Compact and light weight design which can easily be integrated into end products.**
6. **Single power supply +5V drive (except for extended temperature type).**
7. **Low power consumption.**

| | | | PRODUCT SPEC. | MODE NO. FECC1602B-RNNYBW-66LK | PAGE | 19/20 |

## 17. STANDARD FONT MAP

| Upper 4bit / Lower 4bit | 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) | | | | | | | | | | | | | | | |

## 18. PACKING DETAIL

| WITH LED BKL | WITHOUT LED BKL | NOTE |
|---|---|---|
| 45 PCS/BOX | 45 PCS/BOX | 1. The weight is estimated for reference only. |
| 10 BOXES/CARTON | 10 BOXES/CARTON | 2. Packing detail may be changed without notice. |
| 450 PCS/CARTON | 450 PCS/CARTON | |
| 20.00 KGS/CTN(G.W.) | 18.00 KGS/CTN(G.W.) | |
| 0.07 M$^3$/CARTON | 0.07 M$^3$/CARTON | |

Anti - static Bag

FORDATA
LCD Module

BOX ☞

CARTON ☞
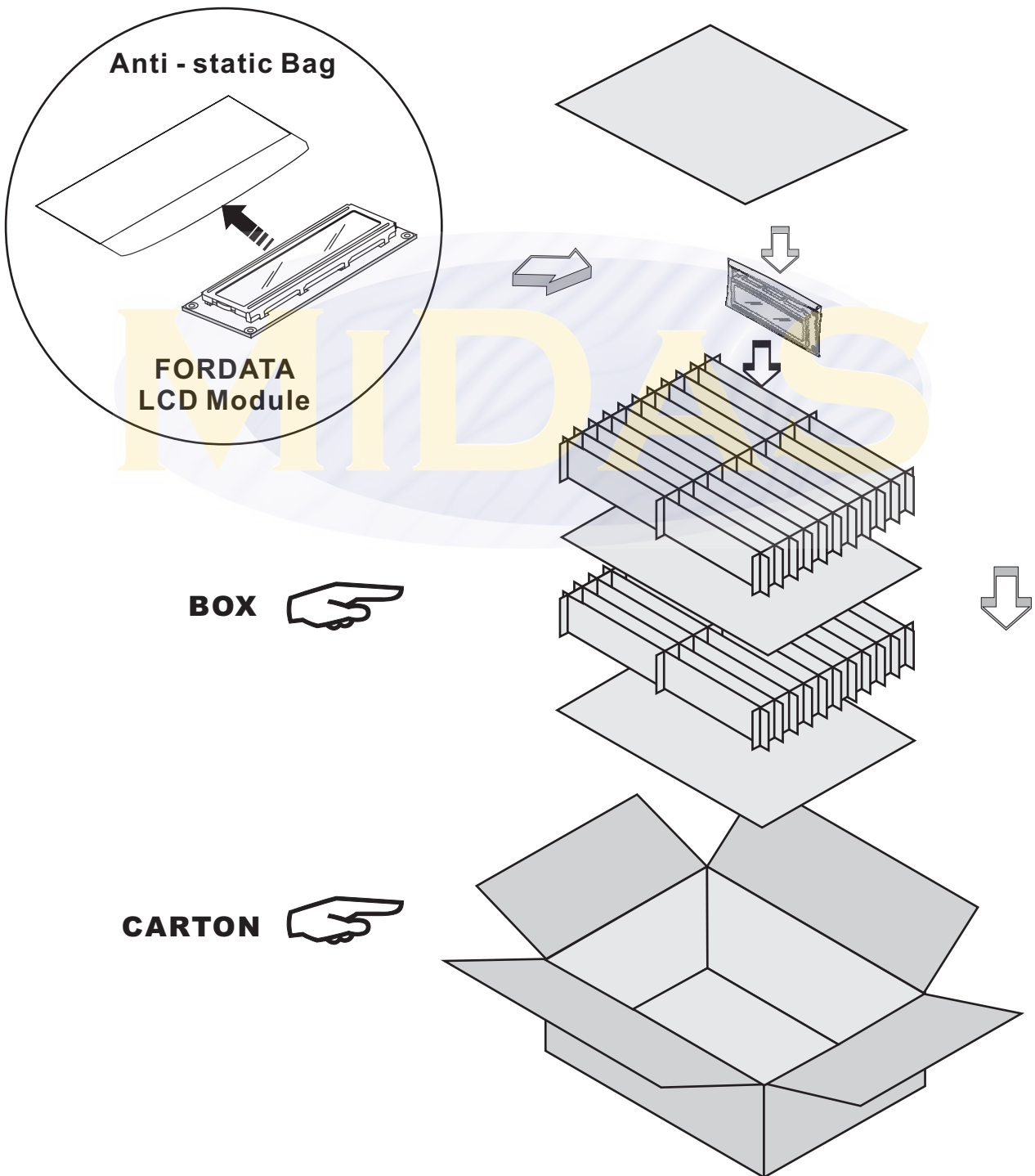
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