

**DISPLAY Elektronik GmbH**

# DATA SHEET

**LCD MODULE**

## **DEM 20488 SYH-PY**

*Product specification*

*Version : 3*

**27/July/2005**

# GENERAL SPECIFICATION

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MODULE NO. :

# DEM 20488 SYH-PY

CUSTOMER P/N

| VERSION NO. | CHANGE DESCRIPTION                  | DATE       |
|-------------|-------------------------------------|------------|
| 0           | ORIGINAL VERSION                    | 08/03/2005 |
| 1           | ADD PCB DRAWING AND DESCRIPTION     | 14/03/2005 |
| 2           | CHANGED SERIES                      | 11/04/2005 |
| 3           | CHANGED PCB DRAWING AND DESCRIPTION | 20/04/2005 |
|             |                                     |            |
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|             |                                     |            |

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DATE: 27/07/2005

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**1.FUNCTIONS & FEATURES**

- LCD Type :

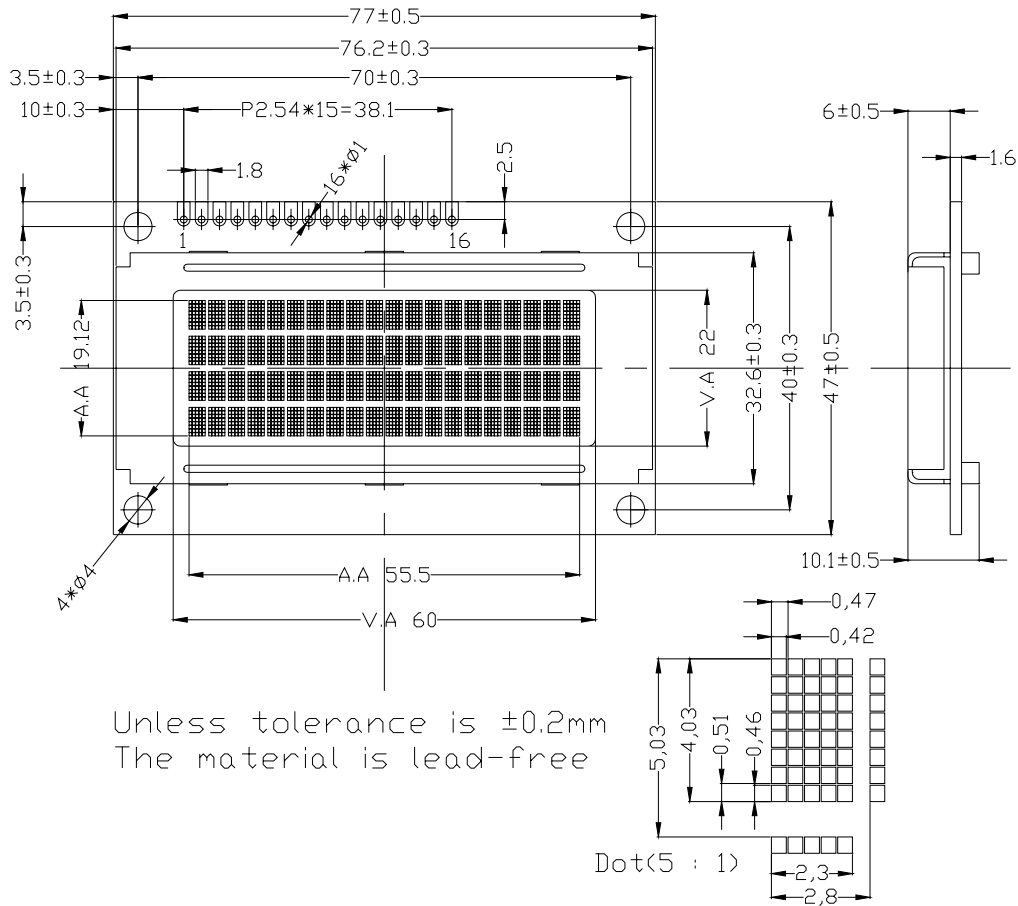
| MODULE           | LCD TECHNOLOGY     | LCD MODE                    |
|------------------|--------------------|-----------------------------|
| DEM 20488 SYH-PY | STN - Yellow/Green | Transflective Positive Mode |

- Viewing Direction : 6 o'clock
- Driving Scheme : 1/16 Duty Cycle, 1/5 Bias
- Power Supply Voltage : 5.0 Volt (typ.)
- V<sub>LCD</sub> (VDD-V0) : 4.5 Volt (typ.)
- Op. Temperature : -20°C...+70°C
- Backlight : LED, Yellow/Green, Lightguide
- Display contents : 20x4Characters (5x8 dots, Format: 208 Kinds )
- Internal Memory : CGROM (10,080 bits )  
: CGRAM (64 x 8 bits )  
: DDRAM (80 x 8 bits for Digits)
- CGROM : CGROM of the ST7066U-0A
- Interface : Easy Interface with a 4-bit or 8-bit MPU

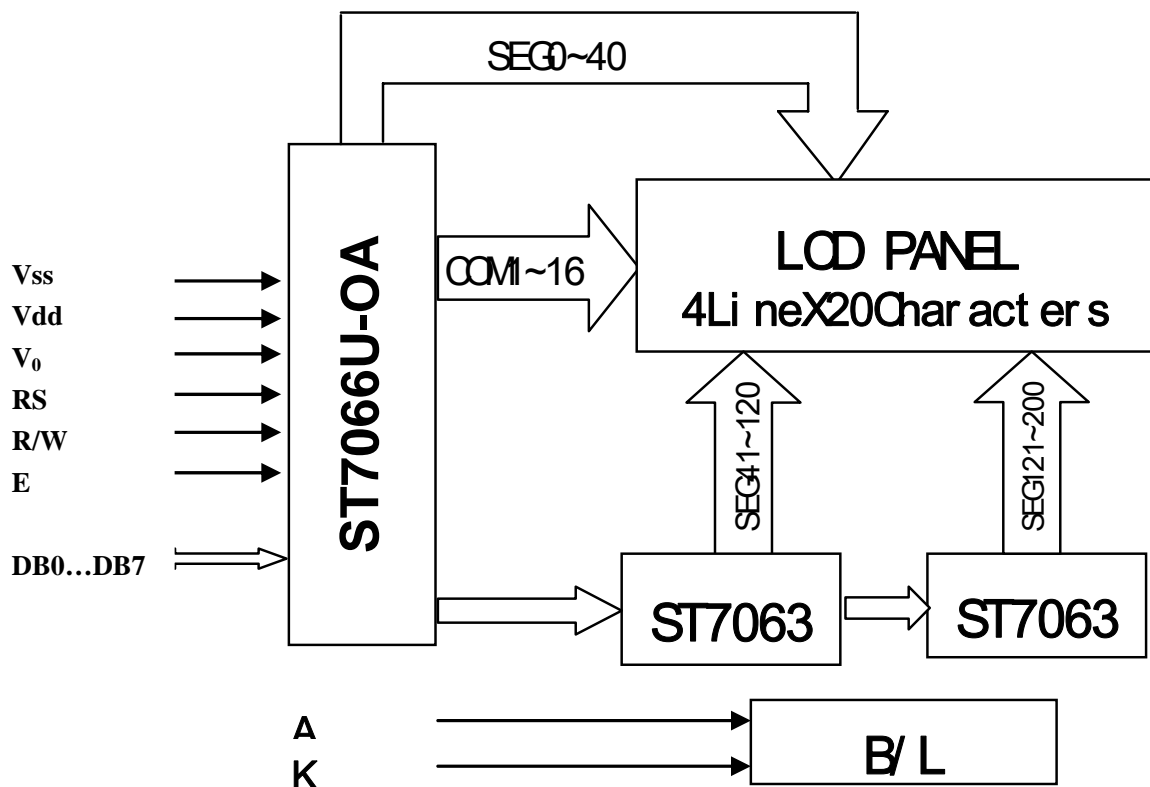
**2. MECHANICAL SPECIFICATIONS**

- Module Size : 77.0 x 47.0 x 10.1 (max.) mm
- Viewing Area : 60.0 x 22.0 mm
- Active Area : 55.5 x 19.12 mm
- Character Pitch : 2.8 x 5.03 mm
- Character Size : 2.3 x 4.03 mm
- Character Font : 5 x 8 dots
- Dot Pitch : 0.47 x 0.51 mm
- Dot Size : 0.42 x 0.46 mm
- Dot Gap : 0.05 mm

3. EXTERNAL DIMENSIONS



4. BLOCK DIAGRAM

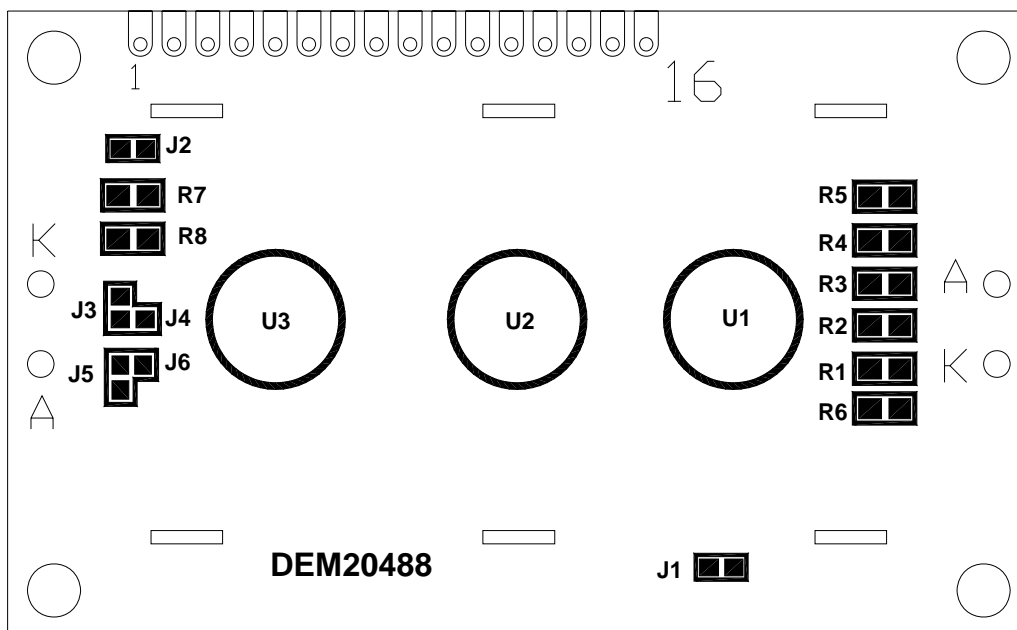


**5. PIN ASSIGNMENT**

| Pin No. | Symbol  | Function  |
|---------|---------|---|
| 1       | Vss     | Ground (0V)   |
| 2       | VDD     | Power supply(VDD>VSS)   |
| 3       | V0      | Operating voltage for LCD   |
| 4       | RS      | Select registers. 0: Instruction register (for write) busy flag; address counter (for read); 1: Data register (for write and read)                                  |
| 5       | R/W     | Select read or write. 0: Write mode; 1: Read mode   |
| 6       | E       | Start enable signal to read or write the data   |
| 7~10    | DB0~DB3 | Four low order bi-directional there-state data bus lines. Use for data transfer between the MPU and the LCD module. These four are not used during 4-bit operation. |
| 11~14   | DB4~DB7 | Four high order bi-directional there-state data bus lines. Used for data transfer between the MPU and the LCD module. DB7 can be used as a busy flag.               |
| 15      | LED(-)  | Please refer to 6-2-1   |
| 16      | LED(+)  | Please refer to 6-2-1   |

**6. PCB DRAWING AND DESCRIPTION**

**6.1 PCB DRAWING**



**6.2 DESCRIPTION:**

6-2-1.The polarity of the pin 15 and the pin 16:

| symbol | symbol<br>state    | J3, J5      | J4, J6      | LED Polarity |         |
|--------|--------------------|-------------|-------------|--------------|---------|
|        |                    |             |             | 15 Pin       | 16 Pin  |
| J4, J6 | Each solder-bridge | Each open   | Each closed | Anode        | Cathode |
| J3, J5 | Each solder-bridge | Each closed | Each open   | Cathode      | Anode   |

Note: In application module: J2=J3=J5= closed, J4=J6= open

6-2-2. The metal-bezel is set on ground when the J1 is closed.

Note: In application module: J1=closed

6-2-3.The LED resistor can be bridged when the J2 is closed

Note: In application module: J2=closed

6-2-4.The R7 and the R8 are the LED resistor.

Note: In application module: R7= R8= open

**6.3 Example application**

6-3-1. The 15 pin is the anode and the 16 pin is the cathode as following.



6-3-2.The 15 pin is the cathode and the 16 pin is the anode as following.



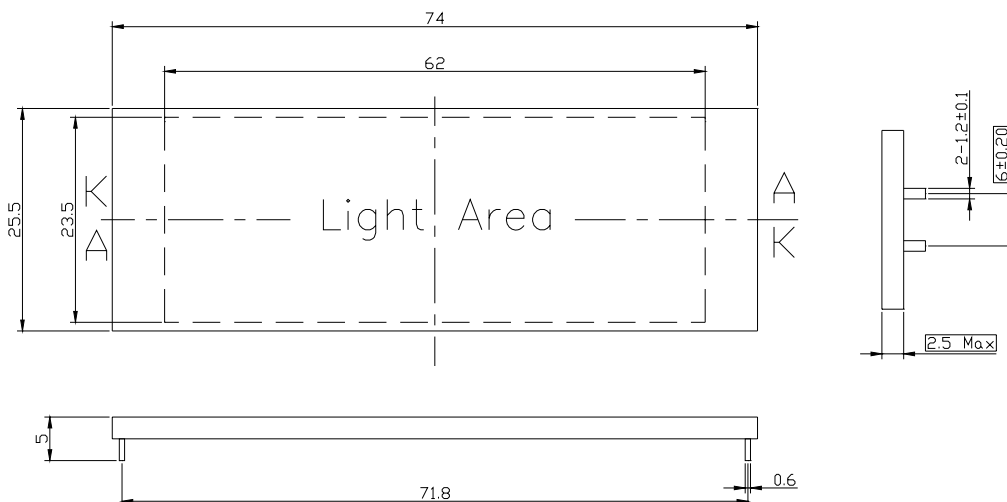
**7. BACKLIGHT**

**7.1 Absolute Maximum Ratings (Ta=25°C)**

| ITEM                             | SYMBOL | CONDITIONS                 | RATING | UNIT |
|----------------------------------|--------|----------------------------|--------|------|
| Absolute maximum forward current | Ifm    |                            | 50     | mA   |
| Peak forward current             | Ifp    | 1 msec plus 10% duty cycle | 60     | mA   |
| Reverse voltage                  | Vr     |                            | 5      | V    |
| Power dissipation                | Pd     |                            | 120x2  | mW   |

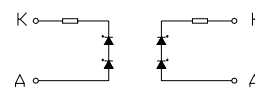
**7.2 Electrical-Optical Characteristics**

| ITEM                     | SYMBOL          | MIN. | TYP. | MAX  | UNIT              | CONDITION |
|--------------------------|-----------------|------|------|------|-------------------|-----------|
| Forward Current          | If              | ---  | 12x2 | 15x2 | mA                | Vf=4.5V   |
| Reverse Current          | Ir              | ---  | 15x2 | ---  | uA                | Vr=4V     |
| Peak Wave length         | $\lambda P$     | 569  | 572  | 575  | nm                | If=20*2mA |
| Spectral Line Half Width | $\Delta\lambda$ | ---  | 30   | ---  | nm                | If=20*2mA |
| Luminance                | Lv              | ---  | ---  | ---  | cd/m <sup>2</sup> | Vf=4.5V   |
| Backlight color          | Yellow-Green    |      |      |      |                   |           |



CIRCUIT DIAGRAM (LED 2X2=4 DICES)

NOTE:  
 1.UNMARKED TOLERANCE IS ±0.30  
 2.BACKLIGHT COLOR IS Yellow-Green



BACKLIGHT, COLOR: Yellow-Green

**8. DISPLAY DATA RAM (DDRAM)**

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

← Display position  
 ← DDRAM Address



**9. MAXIMUM ABSOLUTE POWER RATINGS (Ta = 25°C)**

| Item                  | Symbol           | Standard value                               | Unit |
|-----------------------|------------------|--|------|
| Power supply voltage  | V <sub>DD</sub>  | -0.3 ~ +7.0                                  | V    |
| LCD Driver voltage    | V <sub>LCD</sub> | V <sub>DD</sub> -10.0 ~ V <sub>DD</sub> +0.3 | V    |
| Input voltage         | V <sub>IN</sub>  | -0.3 ~ V <sub>DD</sub> +0.3                  | V    |
| Volt. For BL          | VLED1            | 3.7 ~ 4.1                                    | V    |
| Operating temperature | Topr             | -20 ~ +70                                    | °C   |
| Storage temperature   | Tstg             | -20 ~ +75                                    | °C   |

**10. ELECTRICAL CHARACTERISTICS**

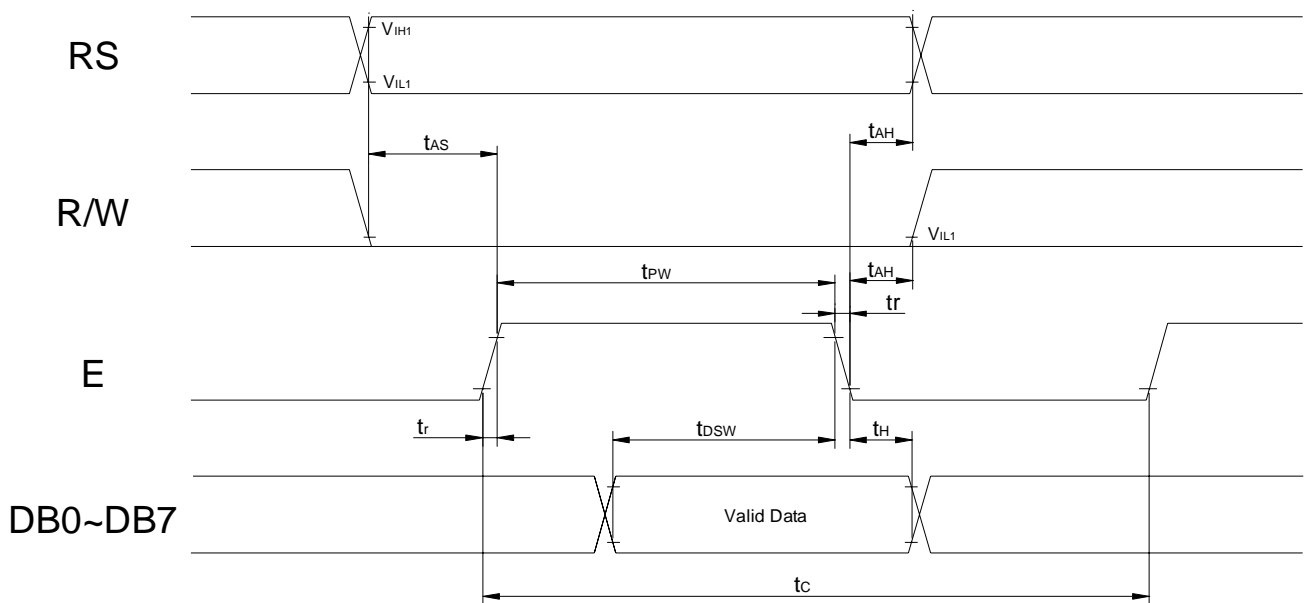
**10-1. DC Characteristics (VDD = 4.5V ~ 5.5V, Ta = -20 ~ +70°C)**

| Item                                      | Symbol            | Standard Value       |      |                    | Test Condition                          | Unit |
|---|-------------------|----------------------|------|--------------------|---|------|
|   |                   | MIN                  | TYP  | MAX                |   |      |
| Operating Voltage                         | V <sub>DD</sub>   | 4.5                  | 5.0  | 5.5                | -----                                   | V    |
| LCD Voltage                               | V <sub>LCD</sub>  | 3.0                  | 4.5  | 10.0               | V <sub>DD</sub> - V5                    | V    |
| Supply Current                            | I <sub>DD</sub>   | ---                  | 0.2  | 0.5                | V <sub>DD</sub> =5V, fosc=270kHz        | mA   |
| Input Voltage (1)<br>(except OSC1)        | V <sub>IL1</sub>  | -0.3                 | --   | 0.6                | -----                                   | V    |
|   | V <sub>IH1</sub>  | 0.7 V <sub>DD</sub>  | --   | V <sub>DD</sub>    | -----                                   |      |
| Input Voltage (2)<br>(OSC1)               | V <sub>IL2</sub>  | ---                  | ---  | 1.0                | -----                                   | V    |
|   | V <sub>IH2</sub>  | V <sub>DD</sub> -1.0 | --   | V <sub>DD</sub>    | -----                                   |      |
| Output Voltage (1)<br>(DB0 to DB7)        | V <sub>OL1</sub>  | ---                  | ---- | 0.4                | I <sub>OL</sub> =0.1mA                  | V    |
|   | V <sub>OH1</sub>  | 3.9                  | ---  | V <sub>DD</sub>    | I <sub>OH</sub> =-0.1mA                 |      |
| Output Voltage (2)<br>(except DB0 to DB7) | V <sub>OL2</sub>  | ---                  | ---  | 0.1V <sub>DD</sub> | I <sub>OL</sub> =0.04mA                 | V    |
|   | V <sub>OH2</sub>  | 0.9V <sub>DD</sub>   | ---  | V <sub>DD</sub>    | I <sub>OH</sub> =-0.04mA                |      |
| Common Resistance                         | R <sub>COM</sub>  | ---                  | 2    | 20                 | V <sub>LCD</sub> =4V, Id=0.05mA         | kΩ   |
| Segment Resistance                        | R <sub>SEG</sub>  | ---                  | 2    | 30                 | V <sub>LCD</sub> =4V, Id=0.05mA         |      |
| Input Leakage Current                     | I <sub>LK1G</sub> | -1                   | ---  | 1                  | V <sub>IN</sub> =0 V to V <sub>DD</sub> | uA   |
| Pull Up MOS Current                       | I <sub>PUP</sub>  | -50                  | -110 | -180               | V <sub>DD</sub> =5V                     | uA   |

**10-2 AC Characteristics (VDD = 5V, Ta = -20 ~ +70°C)**

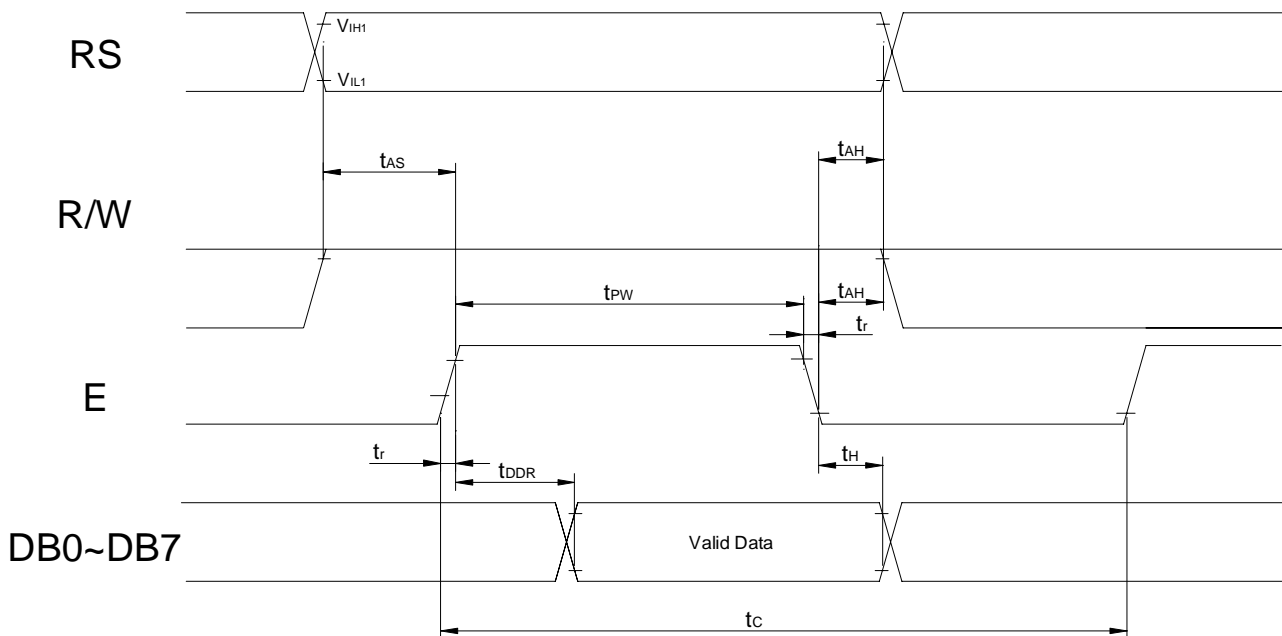
**10-2-1 Write Mode (Writing Data From MPU to module)**

| Characteristic     | Symbol    | Min  | Typ | Max | Unit | Test PIN |
|--------------------|-----------|------|-----|-----|------|----------|
| E Cycle Time       | $t_C$     | 1200 | --- | --- | ns   | E        |
| E Rise Time        | $t_R$     | ---  | --- | 25  | ns   | E        |
| E Fall Time        | $t_F$     | ---  | --- | 25  | ns   | E        |
| E Pulse width      | $t_{PW}$  | 140  | --- | --- | ns   | E        |
| Address Setup Time | $t_{AS}$  | 0    | --- | --- | ns   | R/W,RS,E |
| Address Hold Time  | $t_{AH}$  | 10   | --- | --- | ns   | R/W,RS,E |
| Data Setup Time    | $T_{DSW}$ | 40   | --- | --- | ns   | DB0~DB7  |
| Data Hold Time     | $t_H$     | 10   | --- | --- | ns   | DB0~DB7  |



**10-2-2 Read Mode (Reading Data from module to MPU)**

| Characteristic     | Symbol    | Min  | Typ | Max | Unit | Test PIN |
|--------------------|-----------|------|-----|-----|------|----------|
| E Cycle Time       | $t_C$     | 1200 | --- | --- | ns   | E        |
| E Rise Time        | $t_R$     | ---  | --- | 25  | ns   | E        |
| E Fall Time        | $t_F$     | ---  | --- | 25  | ns   | E        |
| E Pulse width      | $t_{PW}$  | 140  | --- | --- | ns   | E        |
| Address Setup Time | $t_{AS}$  | 0    | --- | --- | ns   | R/W,RS,E |
| Address Hold Time  | $t_{AH}$  | 10   | --- | --- | ns   | R/W,RS,E |
| Data Setup Time    | $t_{DDR}$ | ---  | --- | 100 | ns   | DB0~DB7  |
| Data Hold Time     | $t_H$     | 10   | --- | --- | ns   | DB0~DB7  |



**11. CONTROL AND DISPLAY COMMAND**

| Command                 | RS | R/W | DB7 | DB6 | DB5 | DB4 | DB3 | DB2 | DB1 | DB0 | Execution time<br>(fosc=270KHz) | Remark   |
|-------------------------|----|-----|-----|-----|-----|-----|-----|-----|-----|-----|---------------------------------|--|
| Clear Display           | 0  | 0   | 0   | 0   | 0   | 0   | 0   | 0   | 0   | 1   | 1.52ms                          | Write "20H" to DDRAM. And set DDRAM address to "00H" from AC   |
| Return home             | 0  | 0   | 0   | 0   | 0   | 0   | 0   | 0   | 1   | x   | 1.52ms                          | Set DDRAM address to "00H" from AC and return cursor to its original position if shifted. The contents of DDRAM are not changed. |
| Entry mode Set          | 0  | 0   | 0   | 0   | 0   | 0   | 0   | 1   | I/D | S   | 37us                            | Sets cursor move direction and specifies display shift. These operations are performed during data write and read.               |
| Display on/off control  | 0  | 0   | 0   | 0   | 0   | 0   | 1   | D   | C   | B   | 37us                            | D=1: entire display on<br>C=1: cursor on<br>B=1: cursor position on  |
| Cursor or Display Shift | 0  | 0   | 0   | 0   | 0   | 1   | S/C | R/L | x   | x   | 37us                            | Set cursor moving and display shift control bit, and the direction, without changing DDRAM data.                                 |
| function Set            | 0  | 0   | 0   | 0   | 1   | DL  | N   | F   | x   | x   | 37us                            | DL: interface data is 8/4 bits<br>N: number of line is 2/1<br>F: font size is 5x11/5x8   |
| Set CGRAM address       | 0  | 0   | 0   | 1   | AC5 | AC4 | AC3 | AC2 | AC1 | AC0 | 37us                            | Set CGRAM address in address counter   |
| Set DDRAM address       | 0  | 0   | 1   | AC6 | AC5 | AC4 | AC3 | AC2 | AC1 | AC0 | 37us                            | Set DDRAM address in address counter   |
| Read busy flag& address | 0  | 1   | BF  | AC6 | AC5 | AC4 | AC3 | AC2 | AC1 | AC0 | 0us                             | Whether during internal operation or not can be known by reading BF. The contents of address counter can also be read.           |
| Write data to RAM       | 1  | 0   | D7  | D6  | D5  | D4  | D3  | D2  | D1  | D0  | 37us                            | Write data into internal RAM (DDRAM/CGRAM)   |
| Read data from RAM      | 1  | 1   | D7  | D6  | D5  | D4  | D3  | D2  | D1  | D0  | 37us                            | Read data from internal RAM (DDRAM / CGRAM)  |

**Note:**

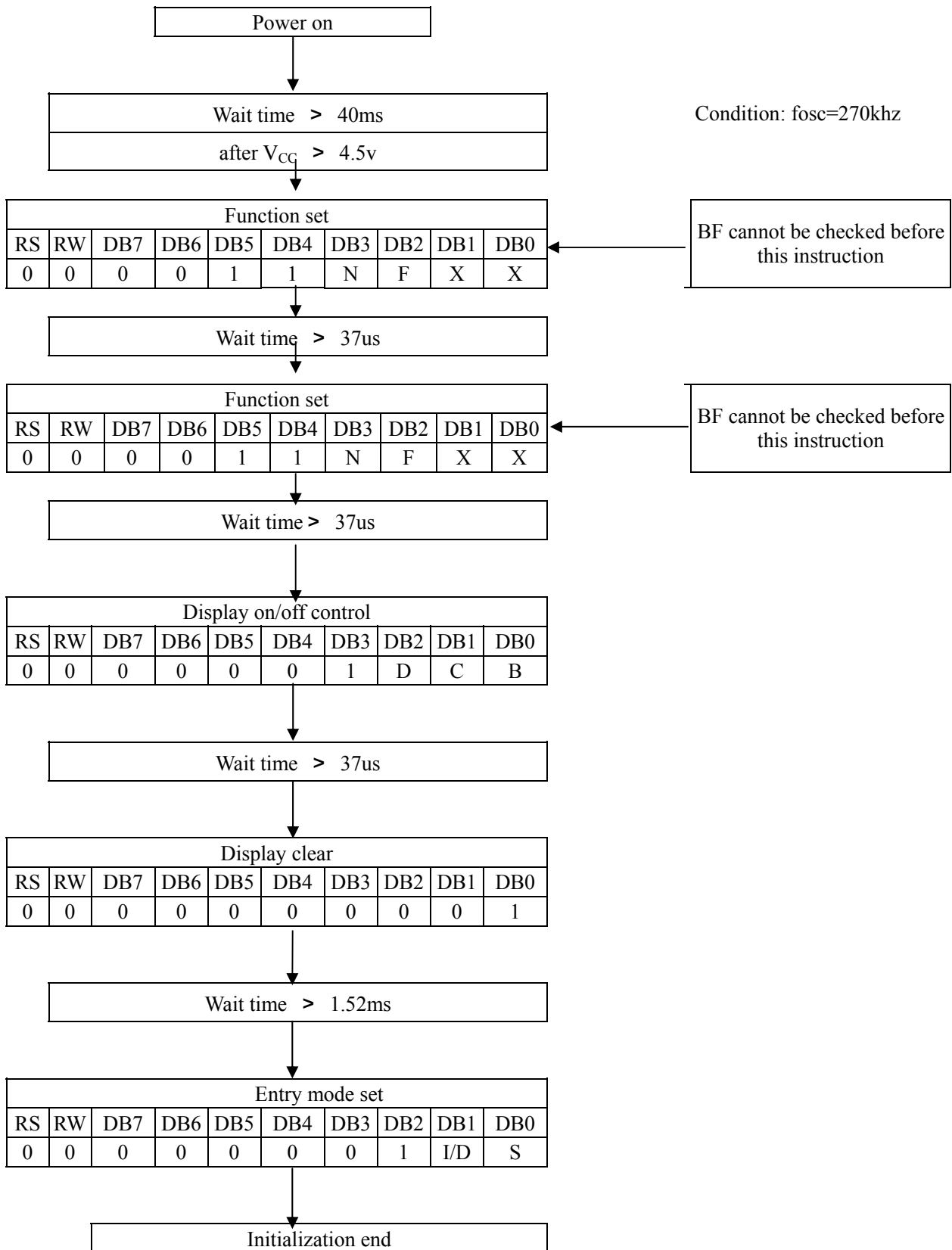
Be sure the ST7066U is not in the busy state (BF=00) before sending an instruction from the MPU to the ST7066U. If an instruction is sent without checking the busy flag, the time between the first instruction and next instruction will take much longer than the instruction time itself. Refer to instruction table for the list of each instruction execution time.

12. STANDARD CHARACTER PATTERN (ST7066U-OA)

| Upper(bits)<br>Lower(bits) |               | 0000 | 0001 | 0010 | 0011 | 0100 | 0101 | 0110 | 0111 | 1000 | 1001 | 10010 | 1011 | 1100 | 1101 | 1110 | 1111 |
|----------------------------|---------------|------|------|------|------|------|------|------|------|------|------|-------|------|------|------|------|------|
| 0000                       | CG RAM<br>(1) |      |      | 0    | 1    | 2    | 3    | 4    | 5    |      |      |       | 6    | 7    | 8    | 9    | 0    |
| 0001                       | (2)           |      | !    | l    | A    | Q    | a    | w    |      |      | e    | 7     | 8    | 9    | 0    | 1    | 2    |
| 0010                       | (3)           |      | "    | 2    | R    | b    | r    |      |      |      | 4    | 5     | 6    | 7    | 8    | 9    | 0    |
| 0011                       | (4)           |      | #    | 3    | S    | s    |      |      |      |      | 7    | 8     | 9    | 0    | 1    | 2    | 3    |
| 0100                       | (5)           |      | \$   | 4    | D    | T    | d    | t    |      |      | 8    | 9     | 0    | 1    | 2    | 3    | 4    |
| 0101                       | (6)           |      | %    | 5    | E    | U    | e    | u    |      |      | 9    | 0     | 1    | 2    | 3    | 4    | 5    |
| 0110                       | (7)           |      | &    | 6    | F    | V    | f    | v    |      |      | 0    | 1     | 2    | 3    | 4    | 5    | 6    |
| 0111                       | (8)           |      | '    | 7    | G    | W    | g    | w    |      |      | 1    | 2     | 3    | 4    | 5    | 6    | 7    |
| 1000                       | (1)           |      | (    | C    | H    | X    | h    | x    |      |      | 2    | 3     | 4    | 5    | 6    | 7    | 8    |
| 1001                       | (2)           |      | )    | 9    | T    | Y    | t    | y    |      |      | 3    | 4     | 5    | 6    | 7    | 8    | 9    |
| 1010                       | (3)           |      | *    | 0    | J    | Z    | j    | z    |      |      | 4    | 5     | 6    | 7    | 8    | 9    | 0    |
| 1011                       | (4)           |      | +    | 1    | K    | L    | k    | l    |      |      | 5    | 6     | 7    | 8    | 9    | 0    | 1    |
| 1100                       | (5)           |      | ,    | <    | U    | F    | l    | l    |      |      | 6    | 7     | 8    | 9    | 0    | 1    | 2    |
| 1101                       | (6)           |      | -    | =    | N    | I    | n    | i    |      |      | 7    | 8     | 9    | 0    | 1    | 2    | 3    |
| 1110                       | (7)           |      | .    | >    | N    | n    | n    | *    |      |      | 8    | 9     | 0    | 1    | 2    | 3    | 4    |
| 1111                       | (8)           |      | /    | ?    | O    | O    | o    | *    |      |      | 9    | 0     | 1    | 2    | 3    | 4    | 5    |

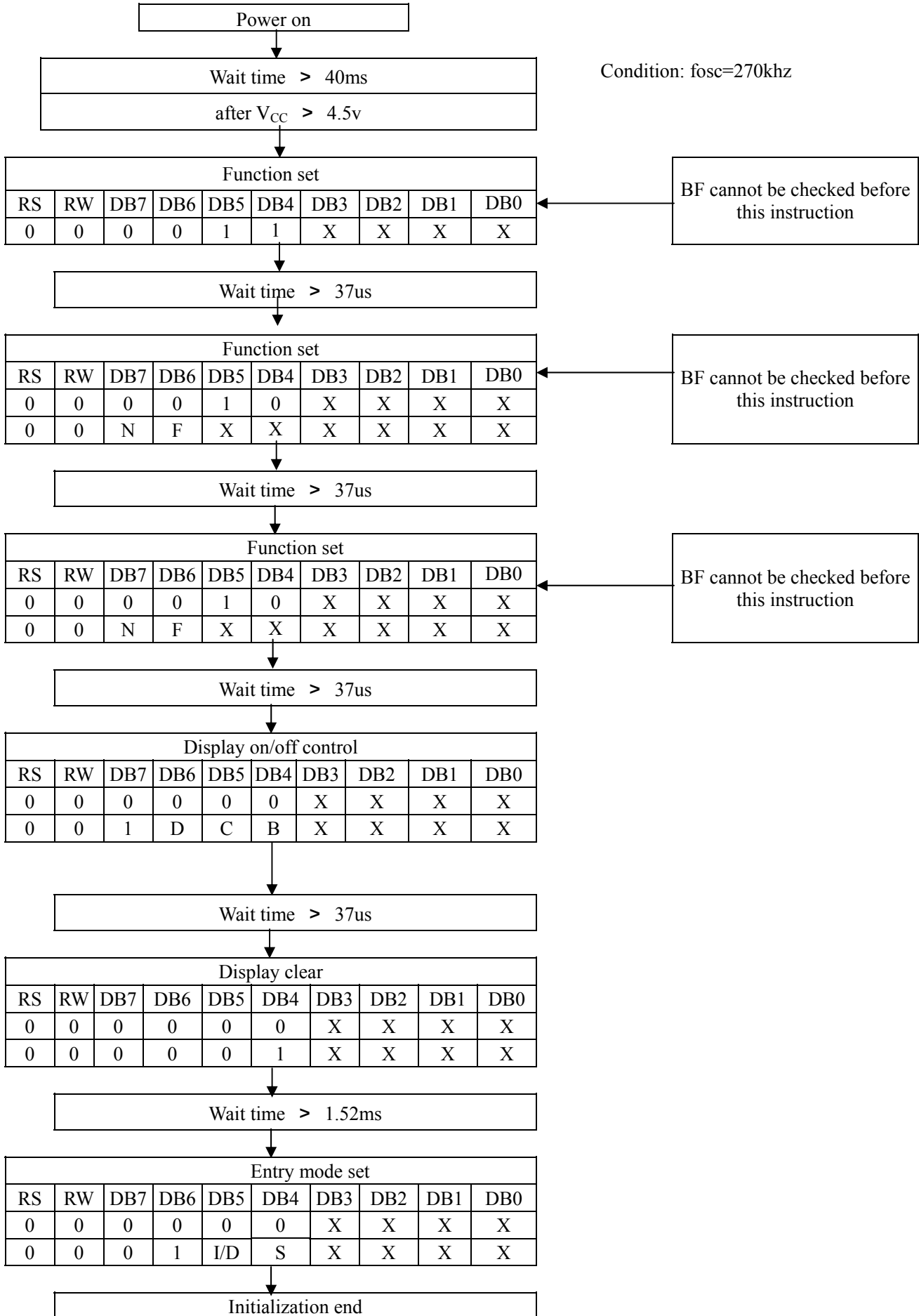
13. LCM INITIALIZING BY INSTRUCTION

13.1. 8-bit Interface Mode



13-2. 4-bit Interface Mode

Condition: fosc=270khz



**14. LCD MODULES HANDLING PRECAUTIONS**

- Please remove the protection foil of polarizer before using.
- The display panel is made of glass. Do not subject it to a mechanical shock by dropping it from a high place, etc.
- If the display panel is damaged and the liquid crystal substance inside it leaks out, do not get any in your mouth. If the substance come into contact with your skin or clothes promptly wash it off using soap and water.
- Do not apply excessive force to the display surface or the adjoining areas since this may cause the color tone to vary.
- The polarizer covering the display surface of the LCD module is soft and easily scratched. Handle this polarize carefully.
- To prevent destruction of the elements by static electricity, be careful to maintain an optimum work environment.
  - Be sure to ground the body when handling the LCD module.
  - Tools required for assembly, such as soldering irons, must be properly grounded.
  - To reduce the amount of static electricity generated, do not conduct assembly and other work under dry conditions.
  - The LCD module is coated with a film to protect the display surface. Exercise care when peeling off this protective film since static electricity may be generated.
- Storage precautions  
When storing the LCD modules, avoid exposure to direct sunlight or to the light of fluorescent lamps. Keep the modules in bags designed to prevent static electricity charging under low temperature / normal humidity conditions (avoid high temperature / high humidity and low temperatures below 0°C).Whenever possible, the LCD modules should be stored in the same conditions in which they were shipped from our company.

**15. OTHERS**

- Liquid crystals solidify at low temperature (below the storage temperature range) leading to defective orientation of liquid crystal or the generation of air bubbles (black or white). Air bubbles may also be generated if the module is subjected to a strong shock at a low temperature.
- If the LCD modules have been operating for a long time showing the same display patterns may remain on the screen as ghost images and a slight contrast irregularity may also appear. Abnormal operating status can be resumed to be normal condition by suspending use for some time. It should be noted that this phenomena does not adversely affect performance reliability.
- To minimize the performance degradation of the LCD modules resulting from caused by static electricity, etc. exercise care to avoid holding the following sections when handling the modules:
  - Exposed area of the printed circuit board
  - Terminal electrode sections