

Display Elektronik GmbH

DATA SHEET

LCD MODULE

DEM 16101 H

Product specification

Version : 5

02/Apr/2003

GENERAL SPECIFICATION

MODULE NO. :

DEM 16101 H

CUSTOMER P/N:

| VERSION NO. | CHANGE DESCRIPTION | DATE |
|-------------|----------------------|------------|
| 0 | ORIGINAL VERSION | 2000/03/06 |
| 1 | ADDING DDRAM ADDRESS | 2001/03/15 |
| 2 | LCD VERSION CHANGED | 2001/04/17 |
| 3 | ADD VERSIONG | 2001/09/22 |
| 4 | VLCD AMENDMENT | 2001/10/05 |
| 5 | LCD VERSION CHANGED | 2002/04/20 |
| | | |
| | | |
| | | |
| | | |
| | | |

PREPARED BY: HZJ

DATE: 2003/04/02

APPROVED BY: MH

DATE: 2003/04/02

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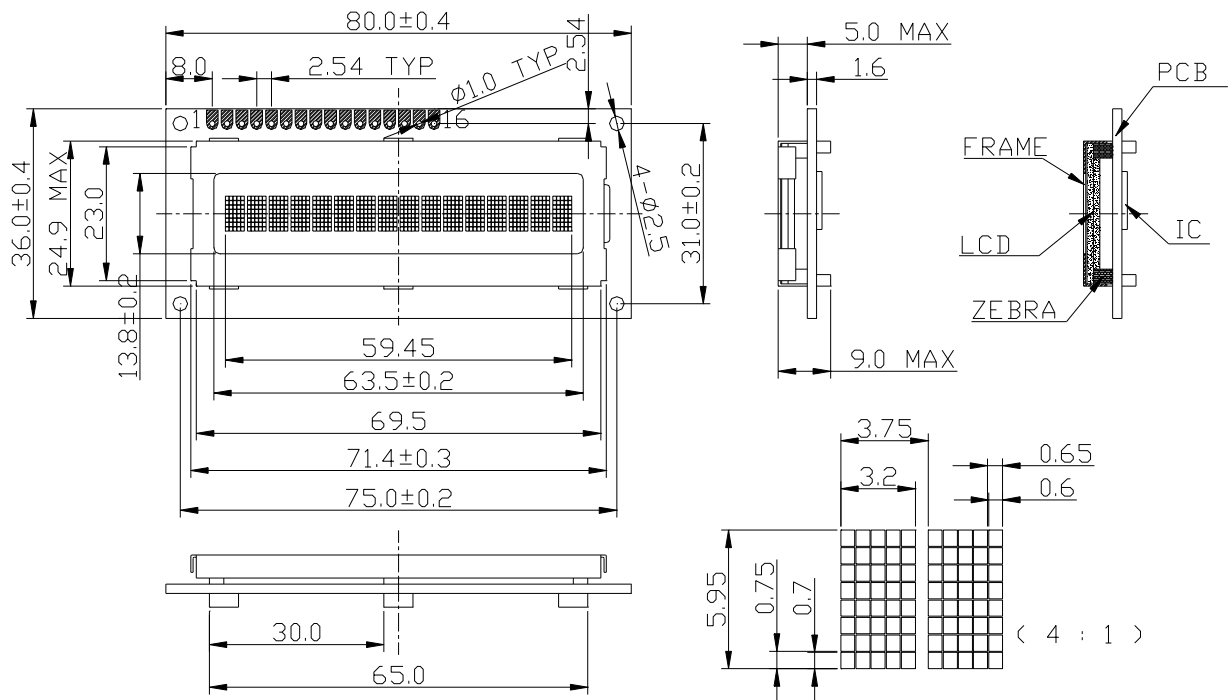
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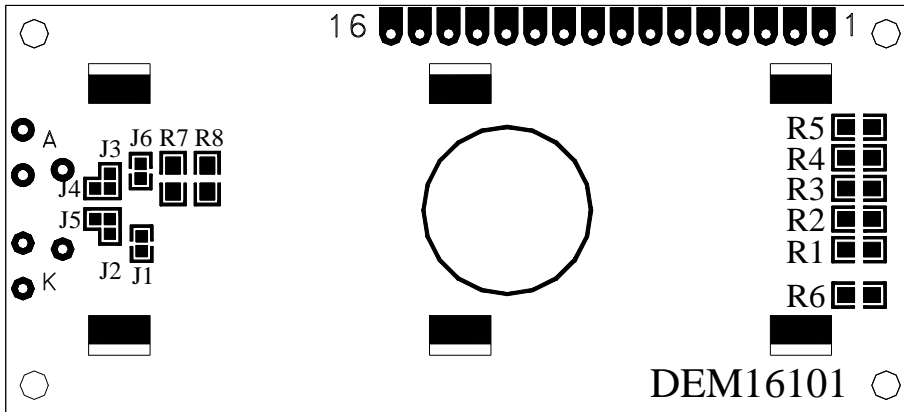
4. EXTERNAL DIMENSIONS



5. PIN ASSIGNMENT

| Pin No. | Symbol | Function |
|---------|-----------------|---|
| 1 | V _{SS} | Ground |
| 2 | V _{DD} | Power supply (5V) |
| 3 | V ₀ | Power Supply for LCD |
| 4 | RS | Select Display Data ("H") or Instructions ("L") |
| 5 | R/W | Read or Write Select Signal |
| 6 | E | Read/Write Enable Signal |
| 7 | DB0 | Display Data Signal |
| 8 | DB1 | |
| 9 | DB2 | |
| 10 | DB3 | |
| 11 | DB4 | |
| 12 | DB5 | |
| 13 | DB6 | |
| 14 | DB7 | |
| 15 | LED-(K) | Not Used (Prepared for version with backlight) |
| 16 | LED+(A) | Not Used (Prepared for version with backlight) |

6.1 PCB DRAWING AND DESCRIPTION



DESCRIPTION: (Not applicable for this version)

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

| symbol | symbol state | J3, J5 | J2, J4 | LED Polarity | |
|--------|--------------------|-----------|-----------|--------------|---------|
| | | | | 15 Pin | 16 Pin |
| J2, J4 | Each solder-bridge | Each open | ----- | Anode | Cathode |
| J3, J5 | Each solder-bridge | ----- | Each open | Cathode | Anode |

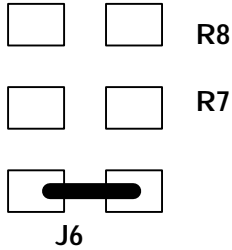
6-1-2. The metal-bezel should be on ground when the J1 is solder-Bridge.

6-1-3. The LED resistor should be bridged when the J6 is solder-Bridge.

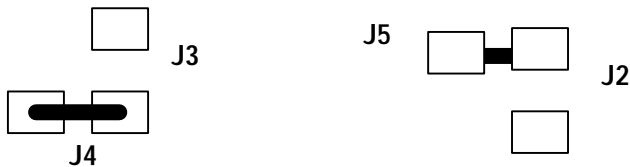
6-1-4. The R7 and the R8 are the LED resistor.

6.2 Example application (Not applicable for this version)

6-2-1. The LED resistor should be bridged as following.



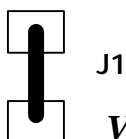
6-2-2. The 15 pin is the anode and the 16 pin is the cathode as following.



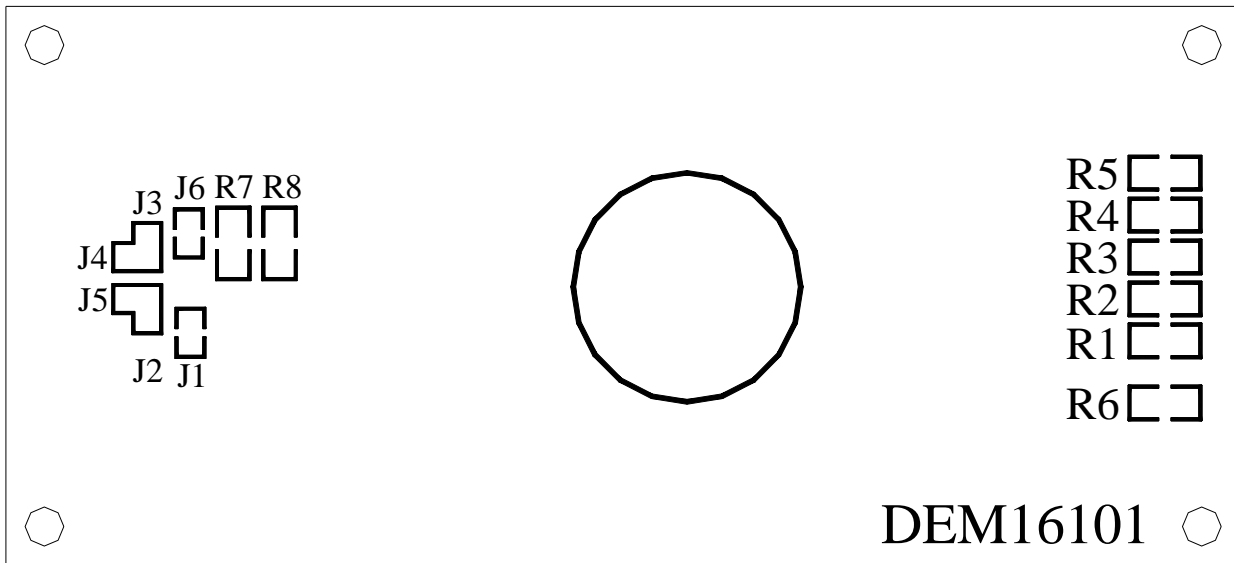
6-2-3. The 15 pin is the cathode and the 16 pin is the anode as following.



6-2-4. The metal-bezel is on ground as following.



6.3 The Module NO. Printed on the PCB.



6.4 DISPLAY DATA RAM(DDRAM)

| | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|
| 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | 14 | 15 | 16 | 17 | 18 | 19 | 20 | 21 | 22 | 23 | 24 | 25 | 26 | 27 | 28 | 29 | 30 | 31 | 32 | 33 | 34 | 35 | 36 | 37 | 38 | 39 | 40 | 41 | 42 | 43 | 44 | 45 | 46 | 47 | |
| 00 | 01 | 02 | 03 | 04 | 05 | 06 | 07 | 08 | 09 | 10 | 11 | 12 | 13 | 14 | 15 | 16 | 17 | 18 | 19 | 20 | 21 | 22 | 23 | 24 | 25 | 26 | 27 | 28 | 29 | 30 | 31 | 32 | 33 | 34 | 35 | 36 | 37 | 38 | 39 | 40 | 41 | 42 | 43 | 44 | 45 | 46 | 47 |

← DISPLAY POSITION
← DDRAM ADDRESS

7. MAXIMUM ABSOLUTE RATINGS

| Item | Symbol | Standard value | Unit |
|--------------------------|-----------|-------------------------------|------|
| Power supply voltage (1) | V_{DD} | -0.3 ~ +7.0 | V |
| Power supply voltage (2) | V_0 | $V_{DD}-13.5 \sim V_{DD}+0.3$ | V |
| Input voltage | V_{IN} | -0.3 ~ $V_{DD}+0.3$ | V |
| Operating temperature | T_{opr} | -20 ~ +70 | °C |
| Storage temperature | T_{stg} | -25 ~ +75 | °C |

*Voltage greater than above may damage to the Circuit.
 $V_{DD} \geq V_1 \geq V_2 \geq V_3 \geq V_4 \geq V_5$

8. ELECTRICAL CHARACTERISTICS

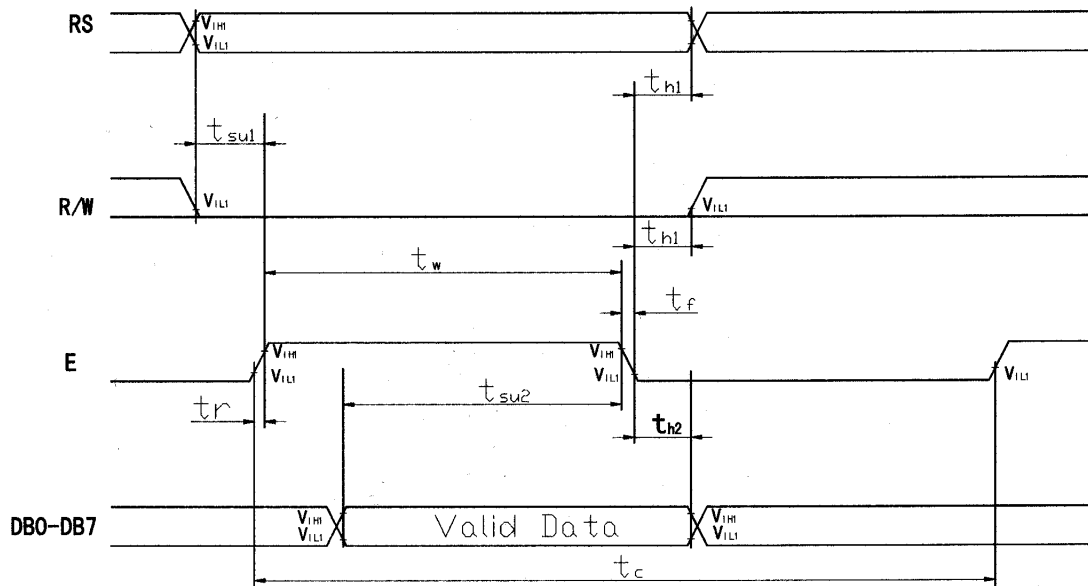
8-1 DC Characteristics (VDD=4.5V ~ 5.5V, Ta = -20 ~ +70°C)

| Item | Symbol | Standard Value | | | Test Condition | Unit |
|---|---------------------------------|----------------------|------|--------------------|---|------|
| | | MIN | TYP | MAX | | |
| Operating Voltage | V _{DD} | 4.5 | 5 | 5.5 | ----- | V |
| Supply Current | I _{DD} | ---- | 0.35 | 0.6 | V _{DD} =5V, f _{osc} =270kHz | mA |
| Input Voltage (1) (except OSC1) | V _{IL1} | -0.3 | -- | 0.6 | ----- | V |
| | V _{IH1} | 2.2 | -- | V _{DD} | ----- | |
| Input Voltage (2) (OSC1) | V _{IL2} | -0.2 | -- | 1.0 | ----- | V |
| | V _{IH2} | V _{DD} -1.0 | -- | V _{DD} | ----- | |
| Output Voltage (1) (DB0 to DB7) | V _{OL1} | --- | ---- | 0.4 | I _{OL} =1.2mA | V |
| | V _{OH1} | 2.4 | --- | ---- | I _{OH} =-0.205mA | |
| Output Voltage (2) (except DB0 to DB7) | V _{OL2} | ----- | --- | 0.1V _{DD} | I _{OL} =40uA | V |
| | V _{OH2} | 0.9V _{DD} | --- | ---- | I _{OH} =-40uA | |
| Voltage Drop | V _{dCOM} | ---- | --- | 1 | I _o = ± 0.1 mA | V |
| | V _{dSEG} | ----- | --- | 1 | | |
| Input Leakage Current | I _{IKG} | -1 | --- | 1 | V _{IN} =0 V to V _{DD} | uA |
| Input Low Current | I _{IL} | -50 | -125 | -250 | V _{IN} =0V, V _{DD} =5V(pull up) | uA |
| Internal Clock (external Rf) | f _{OSC1} | 190 | 270 | 350 | Rf = 91k±2% (V _{DD} =5V) | kHz |
| External Clock | f _{OSC} | 125 | 270 | 410 | ---- | kHz |
| | Duty | 45 | 50 | 55 | ---- | % |
| | t _R , t _F | --- | --- | 0.2 | ---- | us |
| LCD Driving Voltage | V _{LCD} | 3.0 | --- | 13.0 | V _{DD} -V ₅ (1/5, 1/4 Bias) | V |

8-2 AC Characteristics (VDD = 4.5V ~ 5.5V , Ta = -20 ~ +70°C)

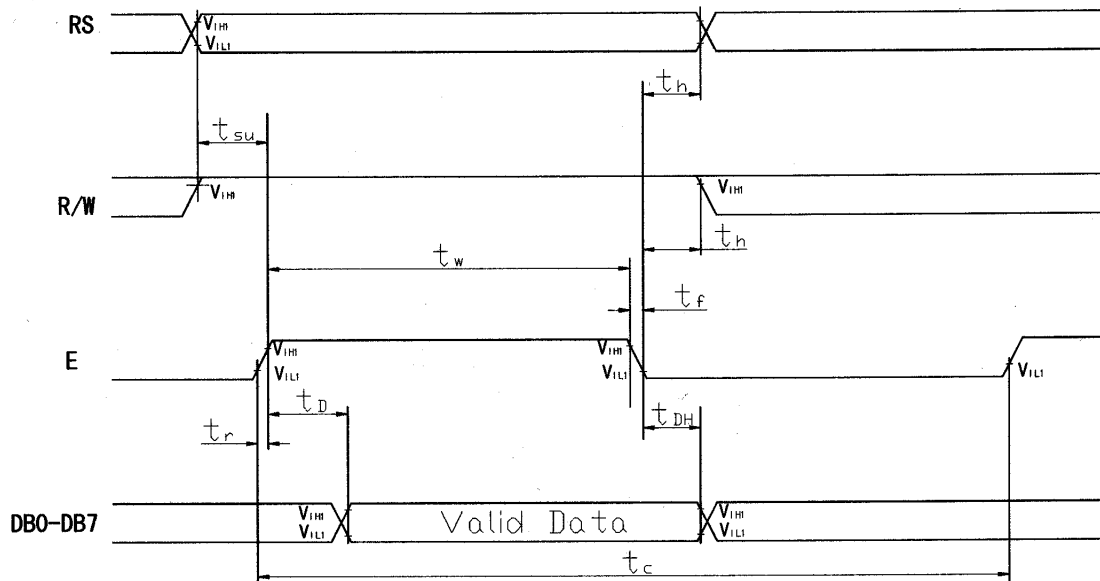
8-2-1 Write mode (writing data from MPU to DEM 16101-Series)

| Characteristic | Symbol | Min | Type | Max | Unit | Test PIN |
|--------------------------|-----------|-----|------|-----|------|----------|
| E Cycle Time | t_c | 500 | --- | --- | ns | E |
| E Rise Time | t_R | --- | --- | 20 | ns | E |
| E Fall Time | t_F | --- | --- | 20 | ns | E |
| E Pulse width (High,Low) | t_w | 230 | --- | --- | ns | E |
| R/W and RS Set-up Time | t_{SU1} | 40 | --- | --- | ns | R/W,RS |
| R/W and RS Hold Time | t_{H1} | 10 | --- | --- | ns | R/W,RS |
| Data Set-up Time | t_{SU2} | 80 | --- | --- | ns | DB0~DB7 |
| Data Hold Time | t_{H2} | 10 | --- | --- | ns | DB0~DB7 |



8-2-2 Read mode (reading data from DEM 16101-Series to MPU)

| Characteristic | Symbol | Min | Type | Max | Unit | Test PIN |
|---------------------------|-----------|-----|------|-----|------|----------|
| E Cycle Time | t_C | 500 | --- | --- | ns | E |
| E Rise Time | t_R | --- | --- | 20 | ns | E |
| E Fall Time | t_F | --- | --- | 20 | ns | E |
| E Pulse width (High, Low) | t_W | 230 | --- | --- | ns | E |
| R/W and RS Set-up Time | t_{SU} | 40 | --- | --- | ns | R/W,RS |
| R/W and RS Hold Time | t_H | 10 | --- | --- | ns | R/W,RS |
| Data Output Delay Time | t_D | --- | --- | 120 | ns | DB0~DB7 |
| Data Hold Time | t_{DH2} | 5 | --- | --- | ns | DB0~DB7 |



9. CONTROL AND DISPLAY COMMAND

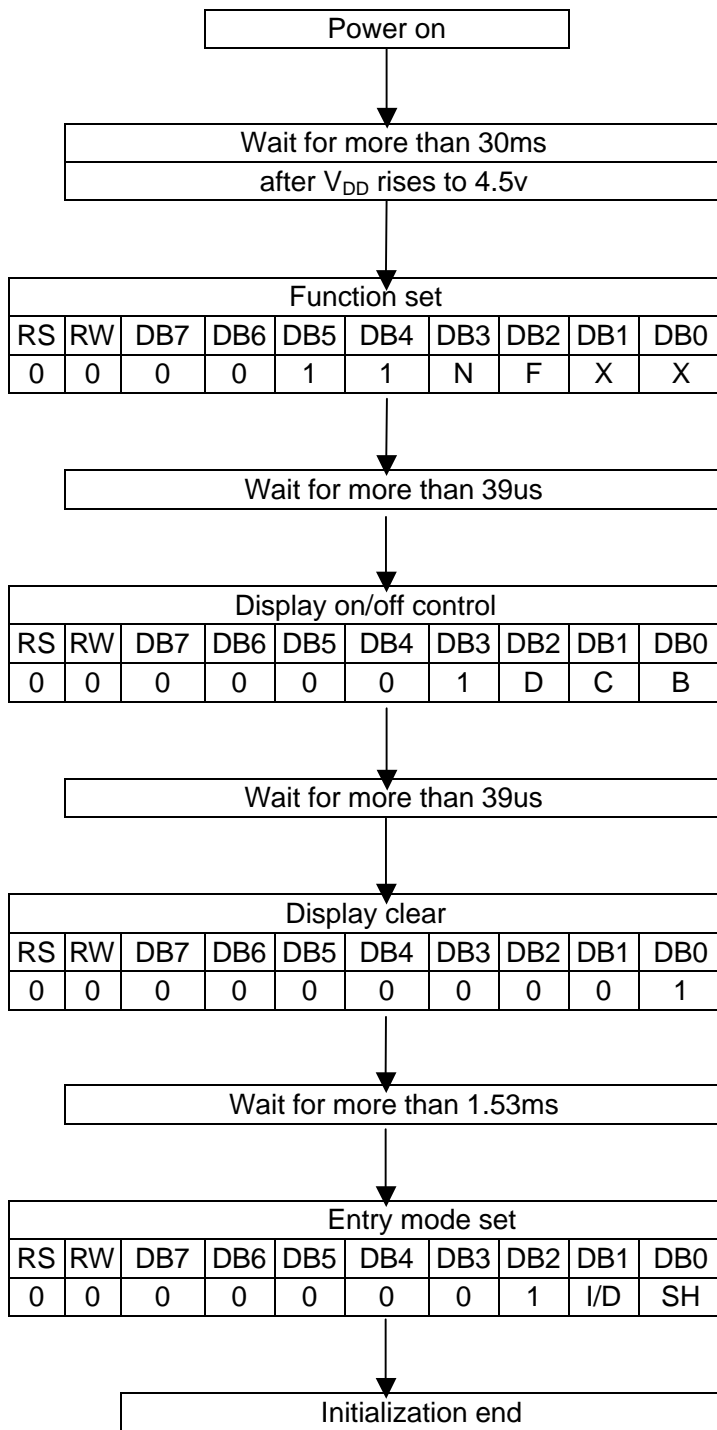
| Command | RS | R/W | DB7 | DB6 | DB5 | DB4 | DB3 | DB2 | DB1 | DB0 | Execution time (fosc=270KHz) | Remark | | | | | | | | | | | | | | | | | | | |
|-------------------------|----|------------------------|-----|-----|-----|-----|-----|-----|-----|-----|------------------------------|--|---|-----|-----------------|------------|-----|-----------------|-------------|----|----------------|--------------------|----|----------------|------------------------|---|------------|-------------|---|-------------|--------------|
| clear Display | L | L | L | L | L | L | L | L | L | H | 1.53ms | Write "20H" to DDRAM and set DDRAM address to "00H" from AC | | | | | | | | | | | | | | | | | | | |
| Return home | L | L | L | L | L | L | L | L | L | H | 1.53ms | Cursor move to first digit | | | | | | | | | | | | | | | | | | | |
| Entry mode set | L | L | L | L | L | L | L | L | H | I/D | SH | 39us | I/D:set cursor move direction <table border="1"> <tr> <td>I/D</td> <td>H</td> <td>Increase</td> </tr> <tr> <td>I/D</td> <td>L</td> <td>Decrease</td> </tr> </table> SH:Specifies shift of display <table border="1"> <tr> <td>SH</td> <td>H</td> <td>Display is shifted</td> </tr> <tr> <td>SH</td> <td>L</td> <td>Display is not shifted</td> </tr> </table> | I/D | H | Increase | I/D | L | Decrease | SH | H | Display is shifted | SH | L | Display is not shifted | | | | | | |
| I/D | H | Increase | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| I/D | L | Decrease | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| SH | H | Display is shifted | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| SH | L | Display is not shifted | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Display on/off control | L | L | L | L | L | L | L | H | D | C | B | 39us | Display <table border="1"> <tr> <td>D</td> <td>H</td> <td>Display on</td> </tr> <tr> <td>D</td> <td>L</td> <td>Display off</td> </tr> </table> Cursor <table border="1"> <tr> <td>C</td> <td>H</td> <td>Cursor on</td> </tr> <tr> <td>C</td> <td>L</td> <td>Cursor off</td> </tr> </table> Blinking <table border="1"> <tr> <td>B</td> <td>H</td> <td>Blinking on</td> </tr> <tr> <td>B</td> <td>L</td> <td>Blinking off</td> </tr> </table> | D | H | Display on | D | L | Display off | C | H | Cursor on | C | L | Cursor off | B | H | Blinking on | B | L | Blinking off |
| D | H | Display on | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| D | L | Display off | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| C | H | Cursor on | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| C | L | Cursor off | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| B | H | Blinking on | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| B | L | Blinking off | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Cursor or Display Shift | L | L | L | L | L | H | S/C | R/L | --- | --- | 39us | <table border="1"> <tr> <td>SC</td> <td>H</td> <td>Display shift</td> </tr> <tr> <td>SC</td> <td>L</td> <td>Cursor move</td> </tr> </table> <table border="1"> <tr> <td>R/L</td> <td>H</td> <td>Right shift</td> </tr> <tr> <td>R/L</td> <td>L</td> <td>Left shift</td> </tr> </table> | SC | H | Display shift | SC | L | Cursor move | R/L | H | Right shift | R/L | L | Left shift | | | | | | | |
| SC | H | Display shift | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| SC | L | Cursor move | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| R/L | H | Right shift | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| R/L | L | Left shift | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| function Set | L | L | L | L | H | DL | N | F | --- | --- | 39us | <table border="1"> <tr> <td>DL</td> <td>H</td> <td>8bits interface</td> </tr> <tr> <td>DL</td> <td>L</td> <td>4bits interface</td> </tr> </table> <table border="1"> <tr> <td>N</td> <td>H</td> <td>2 line display</td> </tr> <tr> <td>N</td> <td>L</td> <td>1 line display</td> </tr> </table> <table border="1"> <tr> <td>F</td> <td>H</td> <td>Display on</td> </tr> <tr> <td>F</td> <td>L</td> <td>Display off</td> </tr> </table> | DL | H | 8bits interface | DL | L | 4bits interface | N | H | 2 line display | N | L | 1 line display | F | H | Display on | F | L | Display off | |
| DL | H | 8bits interface | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| DL | L | 4bits interface | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| N | H | 2 line display | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| N | L | 1 line display | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| F | H | Display on | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| F | L | Display off | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Set CGRAM address | L | L | L | H | AC5 | AC4 | AC3 | AC2 | AC1 | AC0 | 39us | CGRAM data is sent and received after this setting | | | | | | | | | | | | | | | | | | | |
| Set DDRAM address | L | L | H | AC6 | AC5 | AC4 | AC3 | AC2 | AC1 | AC0 | 39us | DDRAM data is sent and received after this setting | | | | | | | | | | | | | | | | | | | |
| Read busy flag& address | L | H | BF | AC6 | AC5 | AC4 | AC3 | AC2 | AC1 | AC0 | 0us | <table border="1"> <tr> <td>BF</td> <td>H</td> <td>Busy</td> </tr> <tr> <td>BF</td> <td>L</td> <td>Ready</td> </tr> </table> -Reads BF indication internal operating is being performed -Reads address counter contents | BF | H | Busy | BF | L | Ready | | | | | | | | | | | | | |
| BF | H | Busy | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| BF | L | Ready | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Write data to RAM | H | L | D7 | D6 | D5 | D4 | D3 | D2 | D1 | D0 | 43us | Write data into DDRAM or CGRAM | | | | | | | | | | | | | | | | | | | |
| Read data from RAM | H | H | D7 | D6 | D5 | D4 | D3 | D2 | D1 | D0 | 43us | Read data from DDRAM or CGRAM | | | | | | | | | | | | | | | | | | | |

10. STANDARD CHARACTER PATTERN

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

11. LCM INITIALIZING BY INSTRUCTION

11-1 8-bit interface mode



Condition : fosc=270khz

| | | |
|---|---|-------------|
| N | 0 | 1-line mode |
| | 1 | 2-line mode |

| | | |
|---|---|-------------|
| F | 0 | display off |
| | 1 | display on |

| | | |
|---|---|-------------|
| D | 0 | display off |
| | 1 | display on |

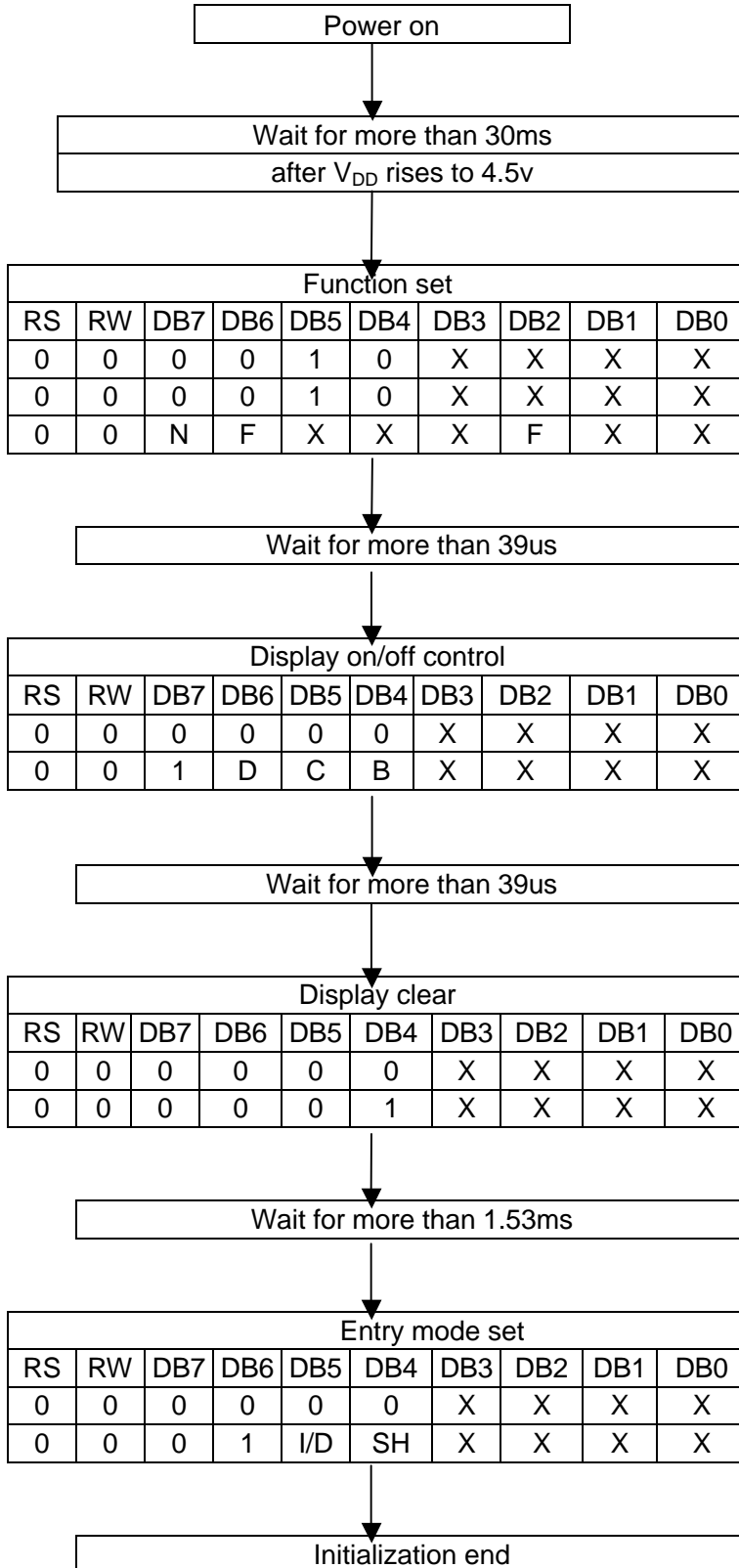
| | | |
|---|---|------------|
| C | 0 | cursor off |
| | 1 | cursor on |

| | | |
|---|---|-----------|
| B | 0 | blink off |
| | 1 | blink on |

| | | |
|-----|---|----------------|
| I/D | 0 | decrement mode |
| | 1 | increment mode |

| | | |
|----|---|------------------|
| SH | 0 | entire shift off |
| | 1 | entire shift on |

11-2 4-bit interface mode



Condition : fosc=270khz

| | | |
|---|---|-------------|
| N | 0 | 1-line mode |
| | 1 | 2-line mode |
| F | 0 | display off |
| | 1 | display on |

| | | |
|---|---|-------------|
| D | 0 | display off |
| | 1 | Display on |
| C | 0 | cursor off |
| | 1 | cursor on |
| B | 0 | blink off |
| | 1 | blink on |

| | | |
|-----|---|------------------|
| I/D | 0 | decrement mode |
| | 1 | increment mode |
| SH | 0 | entire shift off |
| | 1 | entire shift on |

12. LCD Modules Handling Precautions

- 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.

13. 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