

DISPLAY Elektronik GmbH

# DATA SHEET

**LCD MODULE**

**DEM 16102 TGH-CYR22**

*Product specification*

*Version : 0*

**12/Mar/2007**

# GENERAL SPECIFICATION

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MODULE NO. :

DEM 16102 TGH-CYR22

CUSTOMER P/N

| VERSION NO. | CHANGE DESCRIPTION | DATE       |
|-------------|--------------------|------------|
| 0           | ORIGINAL VERSION   | 12/03/2007 |
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PREPARED BY: LMM

DATE: 12/03/2007

APPROVED BY: MH

DATE: 12/03/2007

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## 1. FUNCTIONS & FEATURES

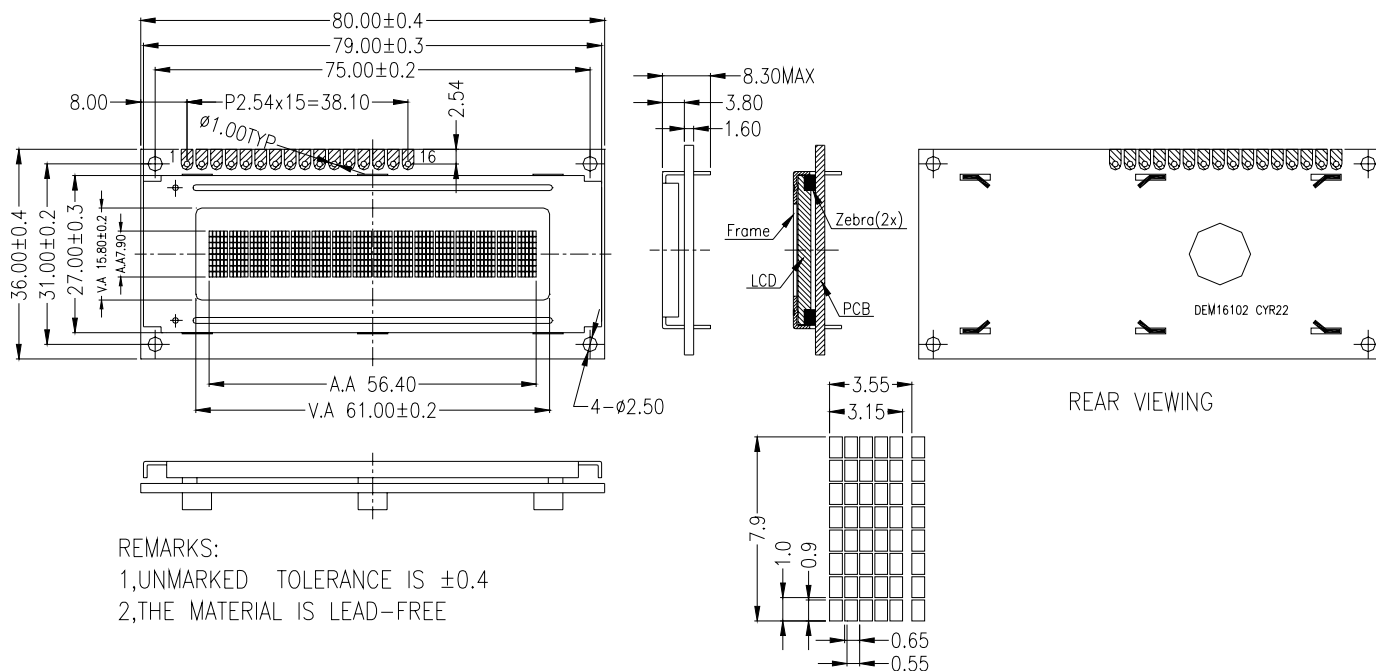
| MODULE NAME         | LCD TYPE                    | REMARK         |
|---------------------|-----------------------------|----------------|
| DEM 16102 TGH-CYR22 | TN Reflective Positive Mode | ROHS Conformed |

- Viewing Direction : 6° clock
- Driving Scheme : 1/16 Duty Cycle, 1/5 Bias
- Power Supply Voltage : 5.0 Volt (typ.)
- $V_{LCD} (V_{DD}-V_0)$  : 4.5 Volt (typ.)
- Operating Temperature : -20°C to +70°C
- Storage Temperature : -25°C to +75°C
- Display contents : 16x1Characters (5x8 dots Format: 204 Kinds )
- Driver IC : S6A0069-22 (Cyrillic font)
- Internal Memory : CGROM (10,080 bits )  
: CGRAM (64 x 8 bits )  
: DDRAM (80 x 8 bits for Digits)
- Interface : Easy Interface with a 4-bit or 8-bit MPU

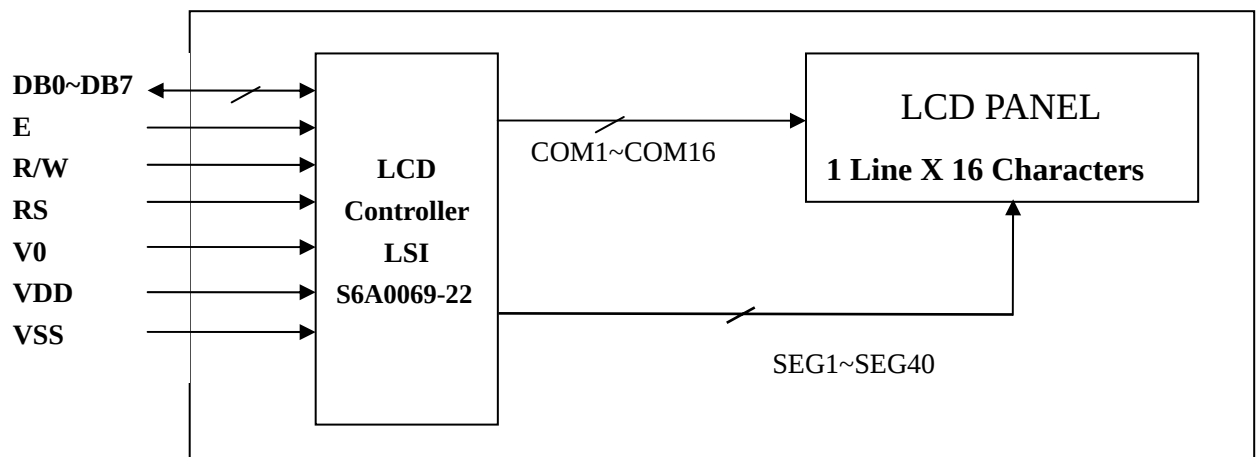
## 2. MECHANICAL SPECIFICATIONS

- Module Size : 80.00 x 36.00 x 8.30 mm
- Dot Size : 0.55 x 0.90 mm
- Dot Gap : 0.10 mm

## 3. EXTERNAL DIMENSIONS



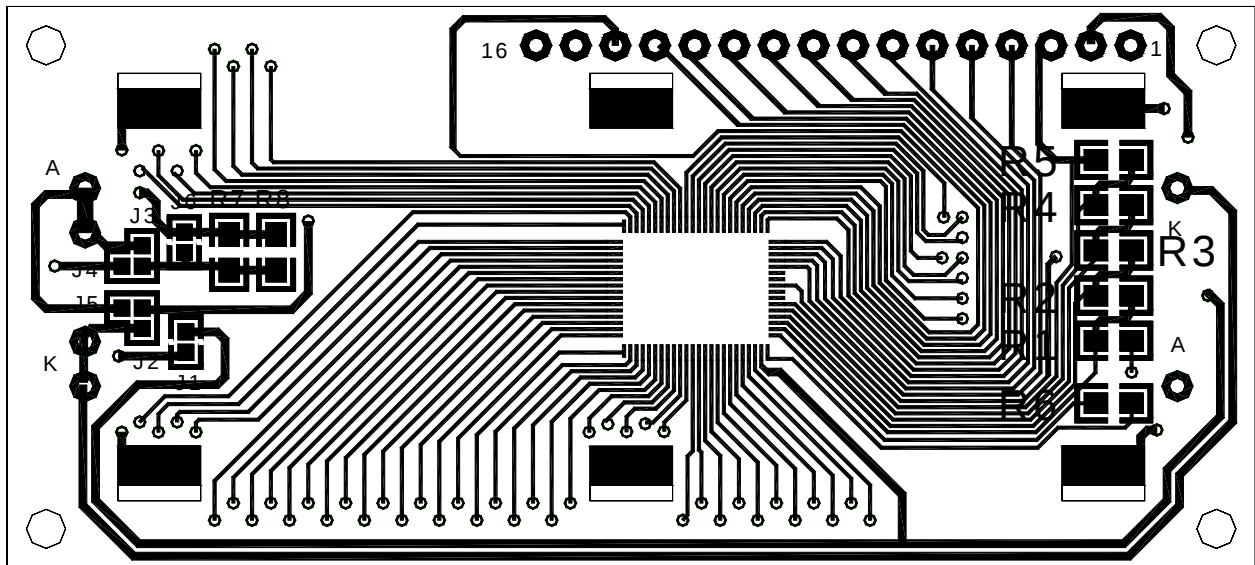
## 4. BLOCK DIAGRAM



## 5. PIN ASSIGNMENT

| Pin No. | Symbol          | Function                                        |
|---------|-----------------|-------------------------------------------------|
| 1       | V <sub>SS</sub> | Ground                                          |
| 2       | V <sub>DD</sub> | Supply terminal of module +5V                   |
| 3       | V <sub>0</sub>  | Power Supply for Liquid Crystal Drive           |
| 4       | RS              | Select Display Data ("1") or Instructions ("0") |
| 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                                        |
| 16      | LED+(A)         |                                                 |

## 6. PCB DRAWING AND DESCRIPTION



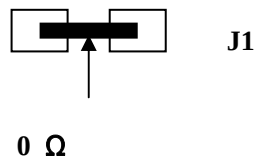
### 6.1 DESCRIPTION:

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

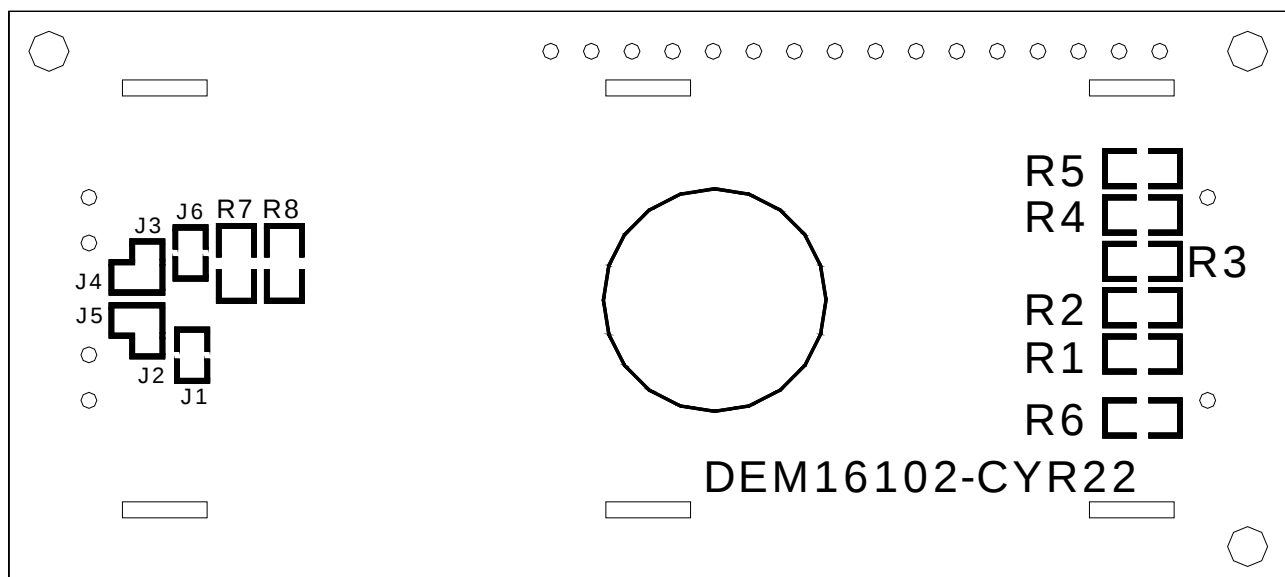
Note: In application module, J1=0  $\Omega$

## 6.2 Example application

6-2-1. The metal-bezel is on ground as following.



### 6.3 The Module Number Printed on the PCB.



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

|            |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |                    |
|------------|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|--------------------|
| FIRST LINE | 1  | 2  | 3  | 4  | 5  | 6  | 7  | 8  | 9  | 10 | 11 | 12 | 13 | 14 | 15 | 16 | ← Display Position |
|            | 00 | 01 | 02 | 03 | 04 | 05 | 06 | 07 | 40 | 41 | 42 | 43 | 44 | 45 | 46 | 47 | ← DDRAM Address    |

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

| Item                     | Symbol           | Standard value                               | Unit |
|--------------------------|------------------|----------------------------------------------|------|
| Power supply voltage (1) | V <sub>DD</sub>  | -0.3 ~ +7.0                                  | V    |
| Power supply voltage (2) | V <sub>LCD</sub> | V <sub>DD</sub> -13.5 ~ V <sub>DD</sub> +0.3 | V    |
| Input voltage            | V <sub>IN</sub>  | -0.3 ~ V <sub>DD</sub> +0.3                  | V    |
| Operating temperature    | T <sub>opr</sub> | -20 ~ +70                                    | °C   |
| Storage temperature      | T <sub>stg</sub> | -25 ~ +75                                    | °C   |

## 9. ELECTRICAL CHARACTERISTICS

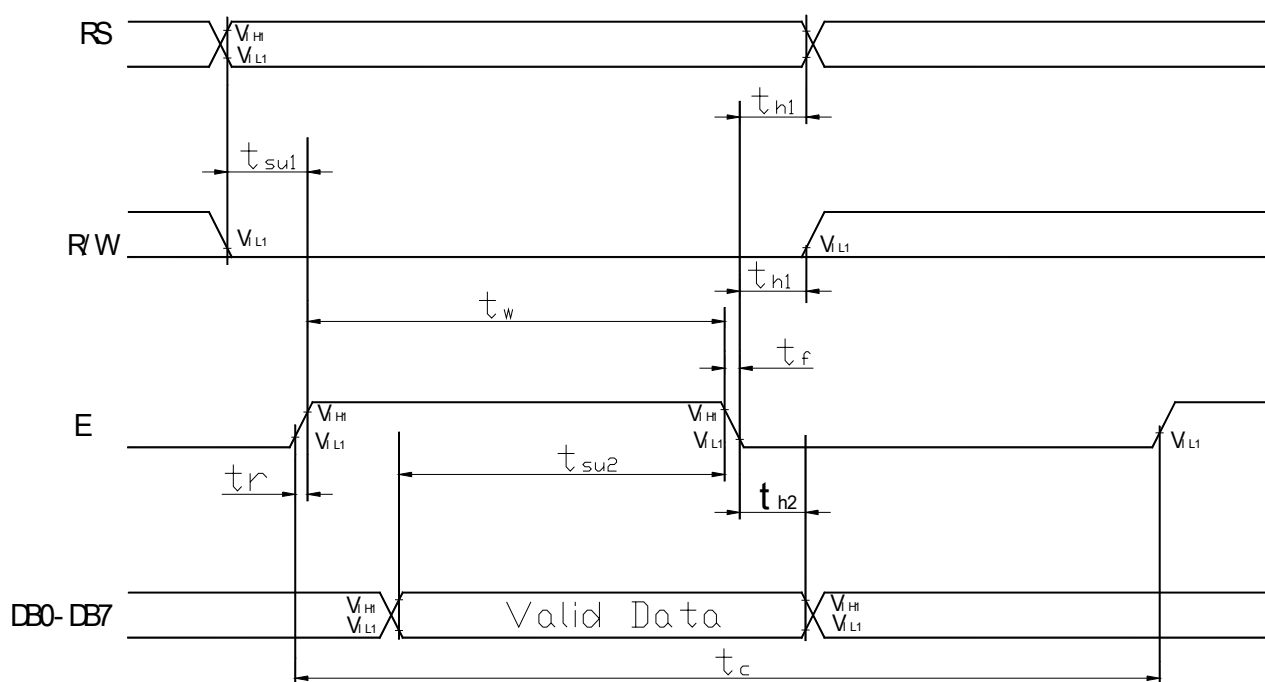
### 9-1 DC Characteristics ( $V_{DD} = 4.5V \sim 5.5V$ )

| 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   |
| LCD Driving Voltage | $V_{LCD}$ | 3.0            | 4.5  | 13.0 | $V_{DD}-V_0$                | V    |

### 9-2 AC Characteristics ( $V_{DD} = 4.5V \sim 5.5V$ )

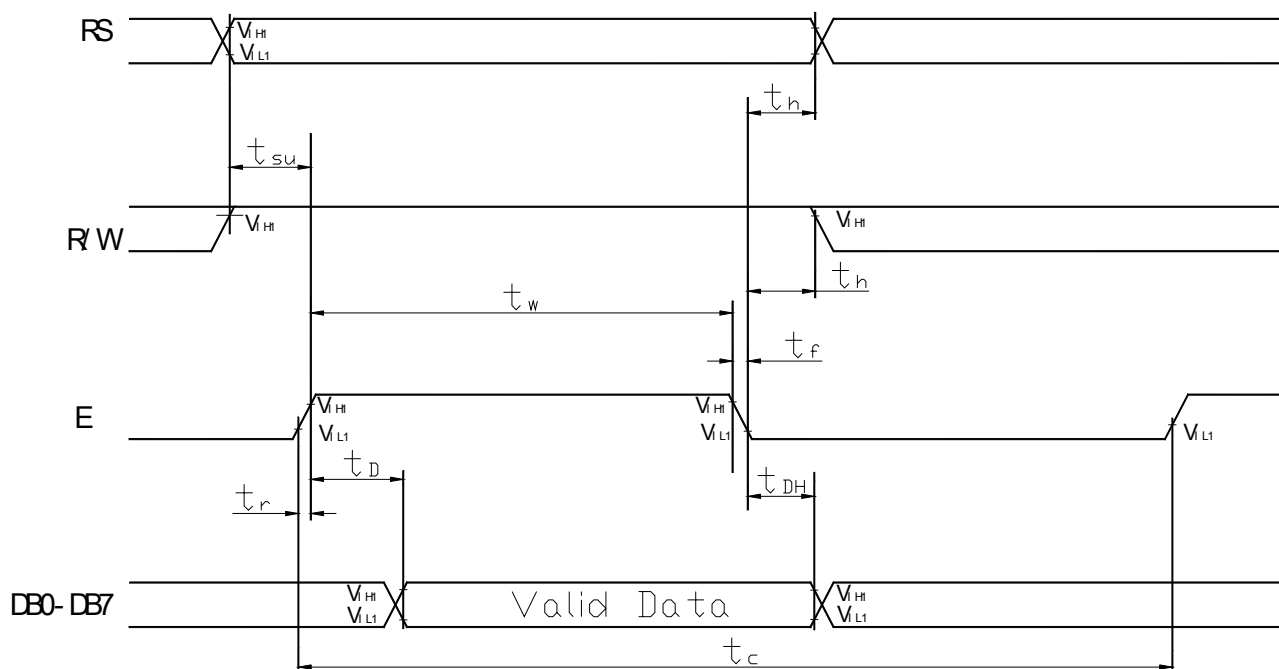
#### 9-2-1 Write mode (writing data from MPU to module)

| Characteristic            | Symbol    | Min | Typ | 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  |



**9-2-2 Read mode (reading data from module to MPU)**

| Characteristic            | Symbol    | Min | Typ | 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   |
| 0Data Output Delay Time   | $t_D$     | --- | --- | 120 | ns   | DB0~DB7  |
| Data Hold Time            | $t_{DH2}$ | 5   | --- | --- | ns   | DB0~DB7  |



## 10. CONTROL AND DISPLAY COMMAND

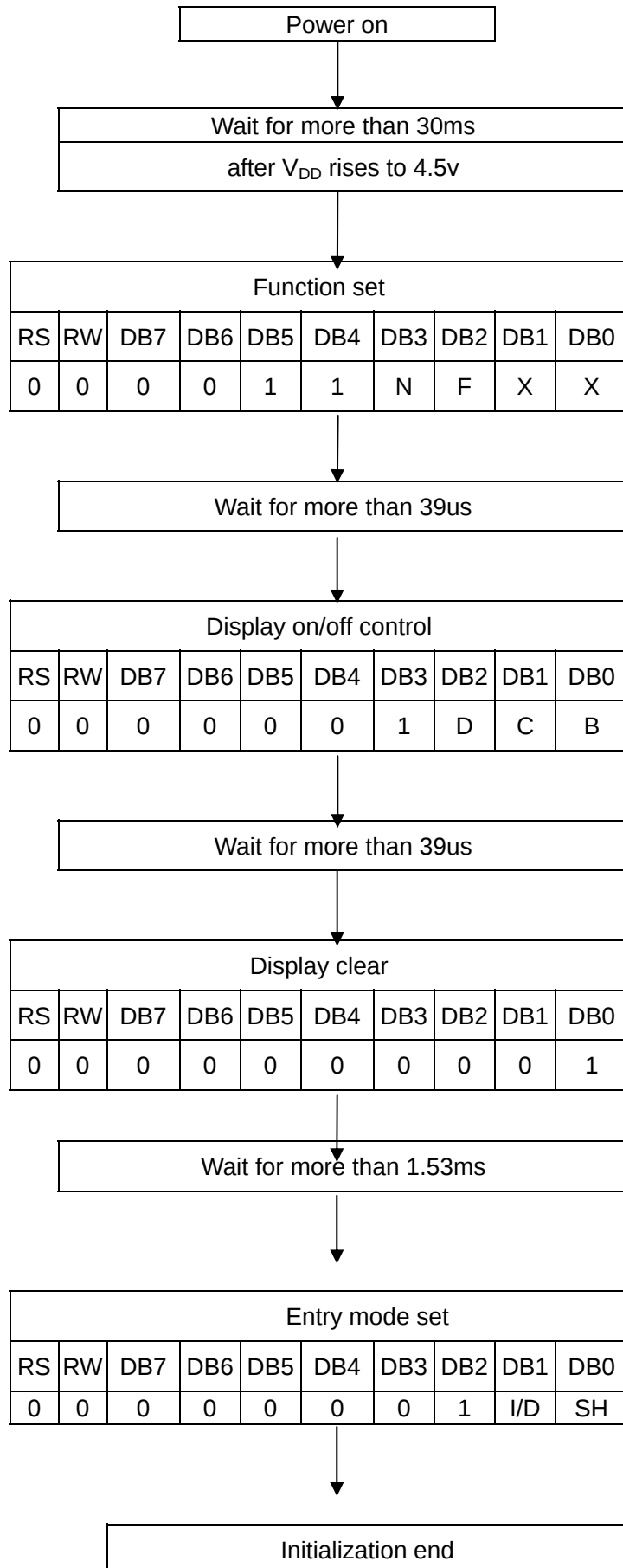
| Command                 | RS                     | R/W          | DB7 | DB6 | DB5 | DB4 | DB3 | DB2 | DB1 | DB0 | Execution time<br>(fosc=270 KHz) | Remark                                                                                           |                 |                    |
|-------------------------|------------------------|--------------|-----|-----|-----|-----|-----|-----|-----|-----|----------------------------------|--------------------------------------------------------------------------------------------------|-----------------|--------------------|
| 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   | H   | --- | 1.53ms                           | Cursor move to first digit                                                                       |                 |                    |
| Entry mode set          | L                      | L            | L   | L   | L   | L   | L   | H   | I/D | SH  | 39us                             | I/D: set cursor move direction                                                                   |                 |                    |
|                         |                        |              |     |     |     |     |     |     |     |     |                                  | I/D                                                                                              | H               | Increase           |
|                         |                        |              |     |     |     |     |     |     |     |     |                                  |                                                                                                  | L               | Decrease           |
|                         |                        |              |     |     |     |     |     |     |     |     |                                  | SH: Specifies shift of display                                                                   |                 |                    |
|                         |                        |              |     |     |     |     |     |     |     |     |                                  | SH                                                                                               | H               | Display is shifted |
| L                       | Display is not shifted |              |     |     |     |     |     |     |     |     |                                  |                                                                                                  |                 |                    |
| Display on/off control  | L                      | L            | L   | L   | L   | L   | H   | D   | C   | B   | 39us                             | Display                                                                                          |                 |                    |
|                         |                        |              |     |     |     |     |     |     |     |     |                                  | D                                                                                                | H               | Display on         |
|                         |                        |              |     |     |     |     |     |     |     |     |                                  |                                                                                                  | L               | Display off        |
|                         |                        |              |     |     |     |     |     |     |     |     |                                  | Cursor                                                                                           |                 |                    |
|                         |                        |              |     |     |     |     |     |     |     |     |                                  | C                                                                                                | H               | Cursor on          |
|                         |                        |              |     |     |     |     |     |     |     |     |                                  |                                                                                                  | L               | Cursor off         |
|                         |                        |              |     |     |     |     |     |     |     |     |                                  | Blinking                                                                                         |                 |                    |
| B                       | H                      | Blinking on  |     |     |     |     |     |     |     |     |                                  |                                                                                                  |                 |                    |
|                         | L                      | Blinking off |     |     |     |     |     |     |     |     |                                  |                                                                                                  |                 |                    |
| Cursor or Display Shift | L                      | L            | L   | L   | L   | H   | S/C | R/L | --- | --- | 39us                             | SC                                                                                               |                 |                    |
|                         |                        |              |     |     |     |     |     |     |     |     |                                  | H                                                                                                | Display shift   |                    |
|                         |                        |              |     |     |     |     |     |     |     |     |                                  | L                                                                                                | Cursor move     |                    |
|                         |                        |              |     |     |     |     |     |     |     |     |                                  | R/L                                                                                              | H               | Right shift        |
| function Set            | L                      | L            | L   | L   | H   | DL  | N   | F   | --- | --- | 39us                             | DL                                                                                               |                 |                    |
|                         |                        |              |     |     |     |     |     |     |     |     |                                  | H                                                                                                | 8bits interface |                    |
|                         |                        |              |     |     |     |     |     |     |     |     |                                  | L                                                                                                | 4bits interface |                    |
|                         |                        |              |     |     |     |     |     |     |     |     |                                  | N                                                                                                | H               | 2 line display     |
|                         |                        |              |     |     |     |     |     |     |     |     |                                  | L                                                                                                | 1 line display  |                    |
| F                       | H                      | 5 x 11 dots  |     |     |     |     |     |     |     |     |                                  |                                                                                                  |                 |                    |
|                         | L                      | 5 x 8 dots   |     |     |     |     |     |     |     |     |                                  |                                                                                                  |                 |                    |
| 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                              | BF                                                                                               |                 |                    |
|                         |                        |              |     |     |     |     |     |     |     |     |                                  | H                                                                                                | Busy            |                    |
|                         |                        |              |     |     |     |     |     |     |     |     |                                  | -Reads BF indication<br>internal operating is being performed<br>-Reads address counter contents |                 |                    |
| 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                                                                    |                 |                    |

## 11. STANDARD CHARACTER PATTERN ( S6A0069-22 )

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

## 12. LCM INITIALIZING BY INSTRUCTION

## 12-1 8-bit Interface Mode



Condition : fosc=270khz

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

|   |   |             |
|---|---|-------------|
| F | 0 | 5 x 8 font  |
|   | 1 | 5 x 11 font |

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

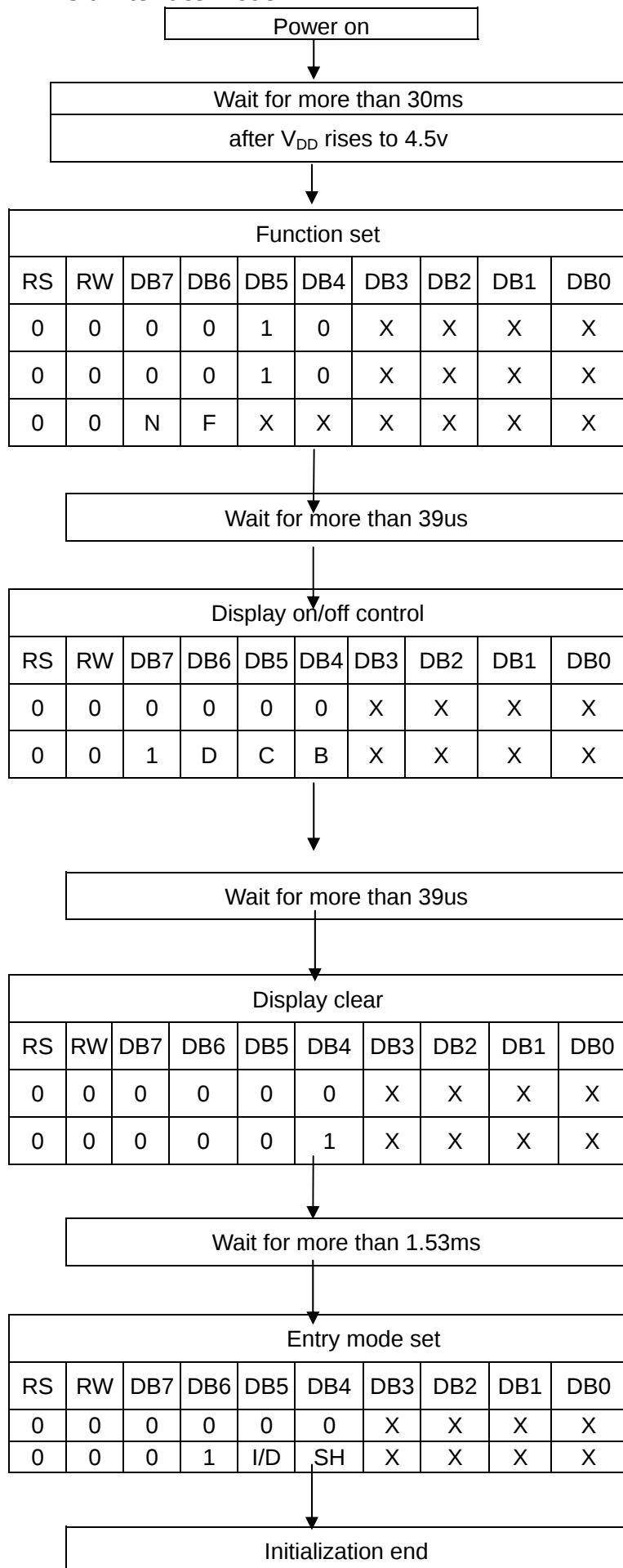
|   |   |            |
|---|---|------------|
| C | 0 | cursor off |
|   | 1 | cursor on  |

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

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

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

12-2 4-bit Interface Mode



Condition : fosc=270khz

|   |   |             |
|---|---|-------------|
| N | 0 | 1-line mode |
|   | 1 | 2-line mode |
| F | 0 | 5 x 8 font  |
|   | 1 | 5 x 11 font |

|   |   |             |
|---|---|-------------|
| 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  |

### **13. 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.

### **14. 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