

2.Precautions in use of LCD Modules

- (1) Avoid applying excessive shocks to the module or making any alterations or modifications to it.
- (2) Don't make extra holes on the printed circuit board, modify its shape or change the components of LCD module.
- (3) Don't disassemble the LCM.
- (4) Don't operate it above the absolute maximum rating.
- (5) Don't drop, bend or twist LCM.
- (6) Soldering: only to the I/O terminals.
- (7) Storage: please storage in anti-static electricity container and clean environment.

3.General Specification

| Item | Dimension | Unit |
|----------------------|--------------------------------|-------------|
| Number of Characters | 16 characters x 2 Lines | — |
| Module dimension | 80.0 x 36.0 x 9.7(MAX) | mm |
| View area | 66.0 x 16.0 | mm |
| Active area | 56.20 x 11.5 | mm |
| Dot size | 0.55 x 0.65 | mm |
| Dot pitch | 0.60 x 0.70 | mm |
| Character size | 2.95 x 5.55 | mm |
| Character pitch | 3.55 x 5.95 | mm |
| LCD type | STN Positive, Gray Reflective, | |
| Duty | 1/16 | |
| View direction | 6 o'clock | |
| Backlight Type | N/A | |

4. Absolute Maximum Ratings

| Item | Symbol | Min | Typ | Max | Unit |
|--------------------------|-----------------|----------|-----|----------|------|
| Operating Temperature | T_{OP} | -20 | — | +70 | °C |
| Storage Temperature | T_{ST} | -30 | — | +80 | °C |
| Input Voltage | V_I | V_{SS} | — | V_{DD} | V |
| Supply Voltage For Logic | $V_{DD}-V_{SS}$ | -0.3 | — | 7 | V |
| Supply Voltage For LCD | $V_{DD}-V_0$ | -0.3 | — | 13 | V |

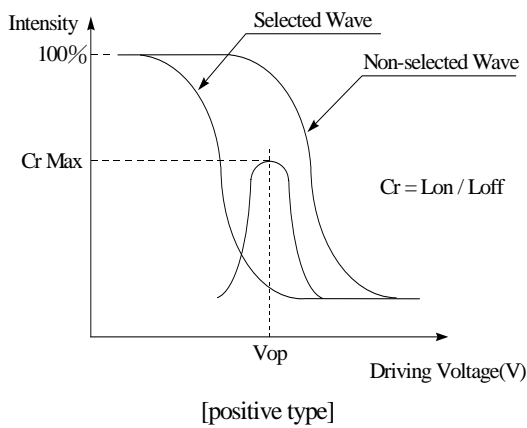
5. Electrical Characteristics

| Item | Symbol | Condition | Min | Typ | Max | Unit |
|--------------------------|-----------------|---------------------------|--------------|-----|----------|------|
| Supply Voltage For Logic | $V_{DD}-V_{SS}$ | — | 4.5 | 5.0 | 5.5 | V |
| Supply Voltage For LCD | $V_{DD}-V_0$ | $T_a=-20^{\circ}\text{C}$ | — | — | 5.2 | V |
| | | $T_a=25^{\circ}\text{C}$ | — | 3.7 | — | V |
| | | $T_a=70^{\circ}\text{C}$ | 3.2 | — | — | V |
| Input High Volt. | V_{IH} | — | $0.7 V_{DD}$ | — | V_{DD} | V |
| Input Low Volt. | V_{IL} | — | V_{SS} | — | 0.6 | V |
| Output High Volt. | V_{OH} | — | 3.9 | — | — | V |
| Output Low Volt. | V_{OL} | — | — | — | 0.4 | V |
| Supply Current | I_{DD} | $V_{DD}=5.0\text{V}$ | 1.0 | 1.2 | 1.5 | mA |

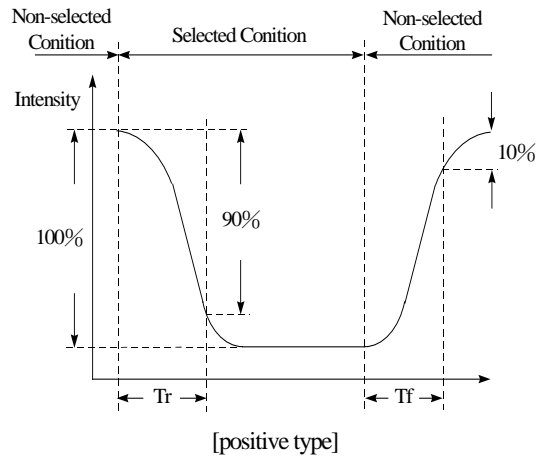
6. Optical Characteristics

| Item | Symbol | Condition | Min | Typ | Max | Unit |
|----------------|---------------|-------------|-----|-----|-----|------|
| View Angle | (V) θ | $CR \geq 2$ | 20 | — | 40 | deg |
| | (H) φ | $CR \geq 2$ | -30 | — | 30 | deg |
| Contrast Ratio | CR | — | — | 3 | — | — |
| Response Time | T rise | — | — | 200 | 300 | ms |
| | T fall | — | — | 200 | 300 | ms |

Definition of Operation Voltage (Vop)



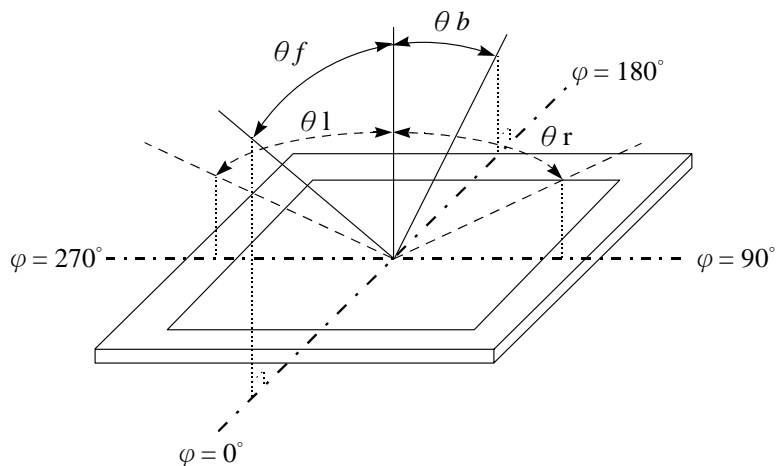
Definition of Response Time (Tr, Tf)



Conditions :

Operating Voltage : Vop Viewing Angle(θ , φ) : 0° , 0°
 Frame Frequency : 64 HZ Driving Waveform : 1/N duty , 1/a bias

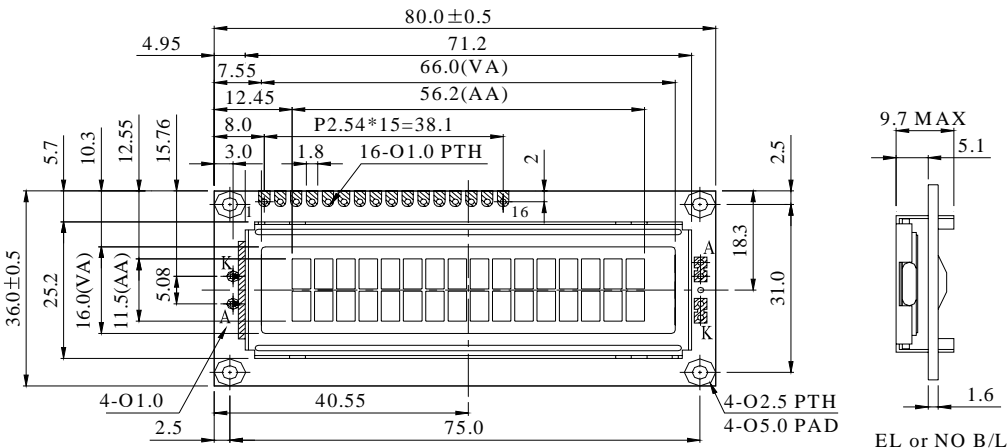
Definition of viewing angle($CR \geq 2$)



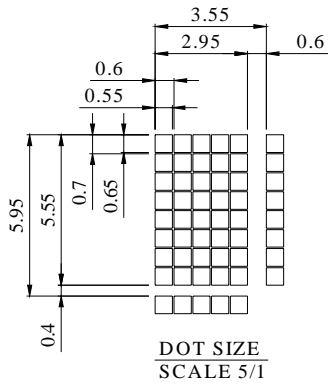
7. Interface Pin Function

| Pin No. | Symbol | Level | Description |
|---------|-----------------|------------|--|
| 1 | V _{SS} | 0V | Ground |
| 2 | V _{DD} | 5.0V | Supply Voltage for logic |
| 3 | VO | (Variable) | Operating voltage for LCD |
| 4 | RS | H/L | H: DATA, L: Instruction code |
| 5 | R/W | H/L | H: Read(MPU→Module) L: Write(MPU→Module) |
| 6 | E | H,H→L | Chip enable signal |
| 7 | DB0 | H/L | Data bus line |
| 8 | DB1 | H/L | Data bus line |
| 9 | DB2 | H/L | Data bus line |
| 10 | DB3 | H/L | Data bus line |
| 11 | DB4 | H/L | Data bus line |
| 12 | DB5 | H/L | Data bus line |
| 13 | DB6 | H/L | Data bus line |
| 14 | DB7 | H/L | Data bus line |
| 15 | NC | | NC |
| 16 | NC | | NC |

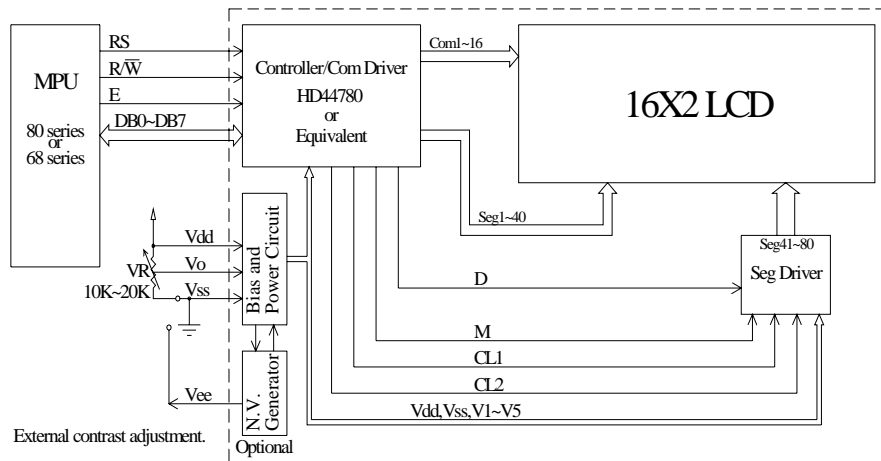
8. Contour Drawing & Block Diagram



| PIN NO. | SYMBOL |
|---------|-----------------|
| 1 | V _{SS} |
| 2 | V _{DD} |
| 3 | V _O |
| 4 | RS |
| 5 | R/W |
| 6 | E |
| 7 | DB0 |
| 8 | DB1 |
| 9 | DB2 |
| 10 | DB3 |
| 11 | DB4 |
| 12 | DB5 |
| 13 | DB6 |
| 14 | DB7 |
| 15 | A |
| 16 | K |



The non-specified tolerance of dimension is $\pm 0.3\text{mm}$.



| Character located | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | 14 | 15 | 16 |
|-------------------|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|
| DDRAM address | 00 | 01 | 02 | 03 | 04 | 05 | 06 | 07 | 08 | 09 | 0A | 0B | 0C | 0D | 0E | 0F |
| DDRAM address | 40 | 41 | 42 | 43 | 44 | 45 | 46 | 47 | 48 | 49 | 4A | 4B | 4C | 4D | 4E | 4F |

9. Function Description

The LCD display Module is built in a LSI controller, the controller has two 8-bit registers, an instruction register (IR) and a data register (DR).

The IR stores instruction codes, such as display clear and cursor shift, and address information for display data RAM (DDRAM) and character generator (CGRAM). The IR can only be written from the MPU. The DR temporarily stores data to be written or read from DDRAM or CGRAM. When address information is written into the IR, then data is stored into the DR from DDRAM or CGRAM. By the register selector (RS) signal, these two registers can be selected.

| RS | R/W | Operation |
|----|-----|---|
| 0 | 0 | IR write as an internal operation (display clear, etc.) |
| 0 | 1 | Read busy flag (DB7) and address counter (DB0 to DB7) |
| 1 | 0 | Write data to DDRAM or CGRAM (DR to DDRAM or CGRAM) |
| 1 | 1 | Read data from DDRAM or CGRAM (DDRAM or CGRAM to DR) |

Busy Flag (BF)

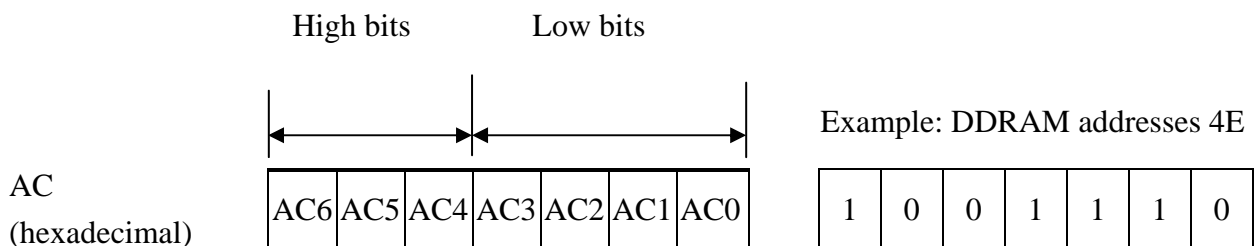
When the busy flag is 1, the controller LSI is in the internal operation mode, and the next instruction will not be accepted. When RS=0 and R/W=1, the busy flag is output to DB7. The next instruction must be written after ensuring that the busy flag is 0.

Address Counter (AC)

The address counter (AC) assigns addresses to both DDRAM and CGRAM

Display Data RAM (DDRAM)

This DDRAM is used to store the display data represented in 8-bit character codes. Its extended capacity is 80x8 bits or 80 characters. Below figure is the relationships between DDRAM addresses and positions on the liquid crystal display.



Display position DDRAM address

| | | | | | | | | | | | | | | | |
|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|
| 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | 14 | 15 | 16 |
| 00 | 01 | 02 | 03 | 04 | 05 | 06 | 07 | 08 | 09 | 0A | 0B | 0C | 0D | 0E | 0F |
| 40 | 41 | 42 | 43 | 44 | 45 | 46 | 47 | 48 | 49 | 4A | 4B | 4C | 4D | 4E | 4F |

2-Line by 16-Character Display

Character Generator ROM (CGROM)

The CGROM generate 5×8 dot or 5×10 dot character patterns from 8-bit character codes. See Table 2.

Character Generator RAM (CGRAM)

In CGRAM, the user can rewrite character by program. For 5×8 dots, eight character patterns can be written, and for 5×10 dots, four character patterns can be written.

Write into DDRAM the character code at the addresses shown as the left column of table 1. To show the character patterns stored in CGRAM.

Relationship between CGRAM Addresses, Character Codes (DDRAM) and Character patterns

Table 1.

For 5 * 8 dot character patterns

| Character Codes (DDRAM data) | | | | | | | | CGRAM Address | | | | | | Character Patterns (CGRAM data) | | | | | | | | | | | | | | | | | | | |
|--------------------------------|---|---|---|-----|---|---|---|---------------|--|--|-----|--|--|-----------------------------------|---|---|---|-----|---|---|----------------|------------------------|---|--|--|--|--|--|-------|---|---|---|----------------|
| 7 | 6 | 5 | 4 | 3 | 2 | 1 | 0 | 5 | | | 4 | | | 3 | | | 2 | | | 1 | | | 0 | | | | | | | | | | |
| High | | | | Low | | | | High | | | Low | | | High | | | | Low | | | | | | | | | | | | | | | |
| 0 0 0 0 * 0 0 0 | | | | | | | | 0 0 0 | | | | | | 0 0 0 | * | * | * | 0 | | | | Character pattern(1) | | | | | | | | | | | |
| | | | | | | | | | | | | | | 0 0 1 | * | * | * | 0 | 0 | 0 | Cursor pattern | | | | | | | | | | | | |
| | | | | | | | | | | | | | | 0 1 0 | * | * | * | 0 | 0 | 0 | | | | | | | | | | | | | |
| | | | | | | | | | | | | | | 0 1 1 | * | * | * | 0 | 0 | 0 | | | | | | | | | | | | | |
| | | | | | | | | | | | | | | 1 0 0 | * | * | * | 0 | 0 | 0 | | | | | | | | | | | | | |
| | | | | | | | | | | | | | | 1 0 1 | * | * | * | 0 | 0 | 0 | | | | | | | | | | | | | |
| | | | | | | | | | | | | | | 1 1 0 | * | * | * | 0 | 0 | 0 | | | | | | | | | | | | | |
| | | | | | | | | | | | | | | 1 1 1 | * | * | * | 0 | 0 | 0 | | | | | | | | | | | | | |
| | | | | | | | | | | | | | | 0 0 0 | * | * | * | 0 | 0 | 0 | | | | | | | | | | | | | |
| | | | | | | | | | | | | | | 0 0 1 | * | * | * | 0 | 0 | 0 | | | | | | | | | | | | | |
| 0 0 0 0 * 0 0 1 | | | | | | | | 0 0 1 | | | | | | 0 1 0 | * | * | * | 0 | 0 | 0 | | Character pattern(2) | | | | | | | | | | | |
| | | | | | | | | | | | | | | 0 1 1 | * | * | * | 0 | 0 | 0 | | | | | | | | | | | | | |
| | | | | | | | | | | | | | | 1 0 0 | * | * | * | 0 | 0 | 0 | | | | | | | | | | | | | |
| | | | | | | | | | | | | | | 1 0 1 | * | * | * | 0 | 0 | 0 | | | | | | | | | | | | | |
| | | | | | | | | | | | | | | 1 1 0 | * | * | * | 0 | 0 | 0 | | | | | | | | | | | | | |
| | | | | | | | | | | | | | | 1 1 1 | * | * | * | 0 | 0 | 0 | | | | | | | | | | | | | |
| | | | | | | | | | | | | | | 0 0 0 | * | * | * | 0 | 0 | 0 | | | | | | | | | | | | | |
| | | | | | | | | | | | | | | 0 0 1 | * | * | * | 0 | 0 | 0 | | | | | | | | | | | | | |
| | | | | | | | | | | | | | | | | | | | | | | | | | | | | | 0 0 0 | * | * | * | Cursor pattern |
| | | | | | | | | | | | | | | | | | | | | | | | | | | | | | 0 0 1 | * | * | * | |
| 0 0 0 0 * 1 1 1 | | | | | | | | 1 1 1 | | | | | | 1 0 0 | * | * | * | | | | | | | | | | | | | | | | |
| | | | | | | | | | | | | | | 1 0 1 | * | * | * | | | | | | | | | | | | | | | | |
| | | | | | | | | | | | | | | 1 1 0 | * | * | * | | | | | | | | | | | | | | | | |
| | | | | | | | | | | | | | | 1 1 1 | * | * | * | | | | | | | | | | | | | | | | |

For 5 * 10 dot character patterns

| Character Codes (DDRAM data) | | | | | | | | | | CGRAM Address | | | | | | Character Patterns (CGRAM data) | | | | | | | | | | |
|--------------------------------|---|---|---|---|-----|---|---|---|--|---------------|---|--|-----|---|--|-----------------------------------|---|---|---|---|-----|---|---|---|----------------|-------------------|
| 7 | 6 | 5 | 4 | 3 | 2 | 1 | 0 | 5 | | | 4 | | | 3 | | | 2 | | | 1 | | | 0 | | | |
| High | | | | | Low | | | | | High | | | Low | | | High | | | | | Low | | | | | |
| 0 0 0 0 * 0 0 0 | | | | | | | | | | 0 0 | | | | | | 0 0 0 0 | * | * | * | 0 | 0 | 0 | 0 | 0 | 0 | Character pattern |
| | | | | | | | | | | | | | | | | 0 0 0 1 | * | * | * | 0 | 0 | 0 | 0 | 0 | | |
| | | | | | | | | | | | | | | | | 0 0 1 0 | * | * | * | 0 | 0 | 0 | 0 | 0 | | |
| | | | | | | | | | | | | | | | | 0 0 1 1 | * | * | * | 0 | 0 | 0 | 0 | 0 | | |
| | | | | | | | | | | | | | | | | 0 1 0 0 | * | * | * | 0 | 0 | 0 | 0 | 0 | | |
| | | | | | | | | | | | | | | | | 0 1 0 1 | * | * | * | 0 | 0 | 0 | 0 | 0 | | |
| | | | | | | | | | | | | | | | | 0 1 1 0 | * | * | * | 0 | 0 | 0 | 0 | 0 | | |
| | | | | | | | | | | | | | | | | 0 1 1 1 | * | * | * | 0 | 0 | 0 | 0 | 0 | | |
| | | | | | | | | | | | | | | | | 1 0 0 0 | * | * | * | 0 | 0 | 0 | 0 | 0 | | |
| | | | | | | | | | | | | | | | | 1 0 0 1 | * | * | * | 0 | 0 | 0 | 0 | 0 | | |
| | | | | | | | | | | | | | | | | 1 0 1 0 | * | * | * | 0 | 0 | 0 | 0 | 0 | Cursor pattern | |
| | | | | | | | | | | | | | | | | 1 0 1 0 | * | * | * | | | | | | | |
| | | | | | | | | | | | | | | | | 1 1 1 1 | * | * | * | * | * | * | * | * | * | |
| | | | | | | | | | | | | | | | | 1 1 1 1 | * | * | * | * | * | * | * | * | | |
| | | | | | | | | | | | | | | | | 1 1 1 1 | * | * | * | * | * | * | * | * | | |
| | | | | | | | | | | | | | | | | 1 1 1 1 | * | * | * | * | * | * | * | * | | |

■ : " High "

10.Character Generator ROM Pattern

Table.2

| Upper 4 bit Lower 4 bit | LLLL | LLLH | LLHL | LLHH | LHLL | LHLH | LHHL | LHHH | HLLL | HLLH | HLHL | HLHH | HHLL | HHLH | HHHL | HHHH |
|----------------------------------|------------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|
| LLLL | CG RAM (1) | ! | " | # | \$ | % | & | ' | (|) | * | + | , | - | . | : |
| LLLH | CG RAM (2) | ; | < | = | > | ?@ | AB | CD | EF | GH | IK | LM | NO | PQ | RS | TU |
| LLHL | CG RAM (3) | V | W | X | Y | Z | [|] | ^ | _ | ` | a | b | c | d | e |
| LLHH | CG RAM (4) | f | g | h | i | j | k | l | m | n | o | p | q | r | s | t |
| LHLL | CG RAM (5) | u | v | w | x | y | z | { | } | ~ | ! | " | # | \$ | % | & |
| LHLH | CG RAM (6) | ' | (|) | * | + | , | - | . | : | ; | < | = | > | ?@ | AB |
| LHHL | CG RAM (7) | CD | EF | GH | IK | LM | NO | PQ | RS | TU | V | W | X | Y | Z | [|
| LHHH | CG RAM (8) |] | ^ | _ | ~ | a | b | c | d | e | f | g | h | i | j | k |
| HLLL | CG RAM (1) | l | m | n | o | p | q | r | s | t | u | v | w | x | y | z |
| HLLH | CG RAM (2) | { | } | ~ | ! | " | # | \$ | % | & | ' | (|) | * | + | , |
| HLHL | CG RAM (3) | - | . | : | ; | < | = | > | ?@ | AB | CD | EF | GH | IK | LM | NO |
| HLHH | CG RAM (4) | PQ | RS | TU | V | W | X | Y | Z | [|] | ^ | _ | ~ | a | b |
| HHLL | CG RAM (5) | c | d | e | f | g | h | i | j | k | l | m | n | o | p | q |
| HHLH | CG RAM (6) | r | s | t | u | v | w | x | y | z | { | } | ~ | ! | " | # |
| HHHL | CG RAM (7) | \$ | % | & | ' | (|) | * | + | , | - | . | : | ; | < | = |
| HHHH | CG RAM (8) | > | ?@ | AB | CD | EF | GH | IK | LM | NO | PQ | RS | TU | V | W | X |

11. Instruction Table

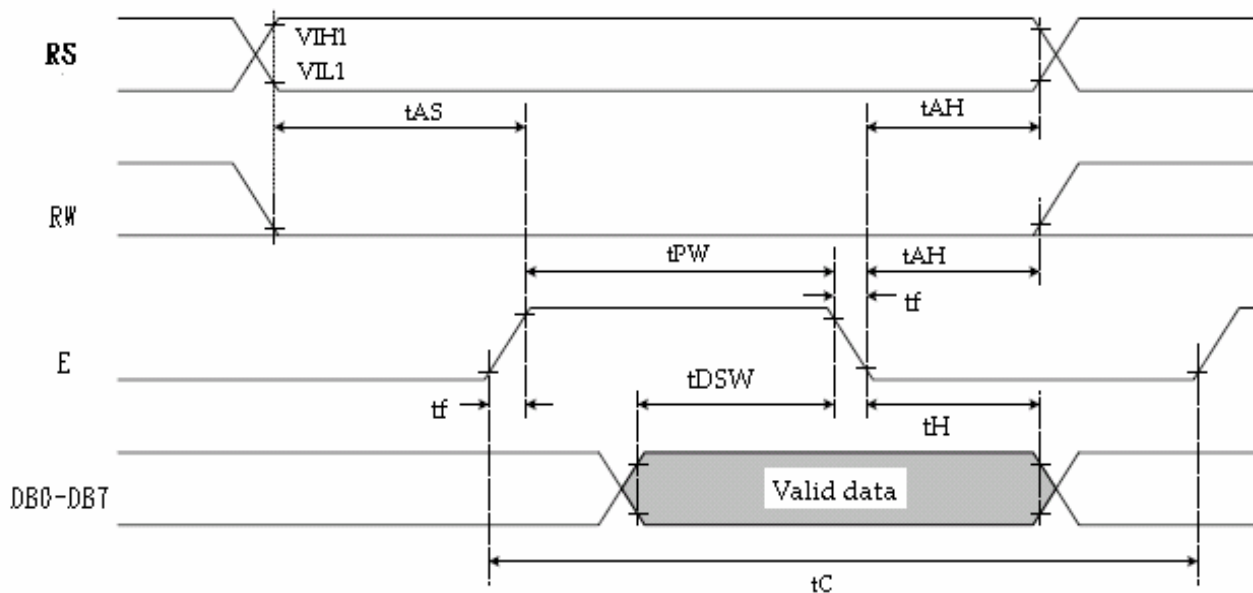
| Instruction | Instruction Code | | | | | | | | | | Description | Execution time (fosc=270Khz) |
|----------------------------|------------------|-----|-----|-----|-----|-----|-----|-----|-----|-----|--|---------------------------------|
| | RS | R/W | DB7 | DB6 | DB5 | DB4 | DB3 | DB2 | DB1 | DB0 | | |
| Clear Display | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | Write "00H" to DDRAM and set DDRAM address to "00H" from AC | 1.53ms |
| 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. | 1.53ms |
| 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. | 39 μ s |
| 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 control bit. | 39 μ s |
| 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 of DDRAM data. | 39 μ s |
| Function Set | 0 | 0 | 0 | 0 | 1 | DL | N | F | — | — | Set interface data length (DL:8-bit/4-bit), numbers of display line (N:2-line/1-line)and, display font type (F:5x11 dots/5x8 dots) | 39 μ s |
| Set CGRAM Address | 0 | 0 | 0 | 1 | AC5 | AC4 | AC3 | AC2 | AC1 | AC0 | Set CGRAM address in address counter. | 39 μ s |
| Set DDRAM Address | 0 | 0 | 1 | AC6 | AC5 | AC4 | AC3 | AC2 | AC1 | AC0 | Set DDRAM address in address counter. | 39 μ s |
| 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 μ s |
| Write Data to RAM | 1 | 0 | D7 | D6 | D5 | D4 | D3 | D2 | D1 | D0 | Write data into internal RAM (DDRAM/CGRAM). | 43 μ s |
| Read Data from RAM | 1 | 1 | D7 | D6 | D5 | D4 | D3 | D2 | D1 | D0 | Read data from internal RAM (DDRAM/CGRAM). | 43 μ s |

* "—" : don't care

12. Timing Characteristics

12.1 Write Operation

- Writing data from MPU

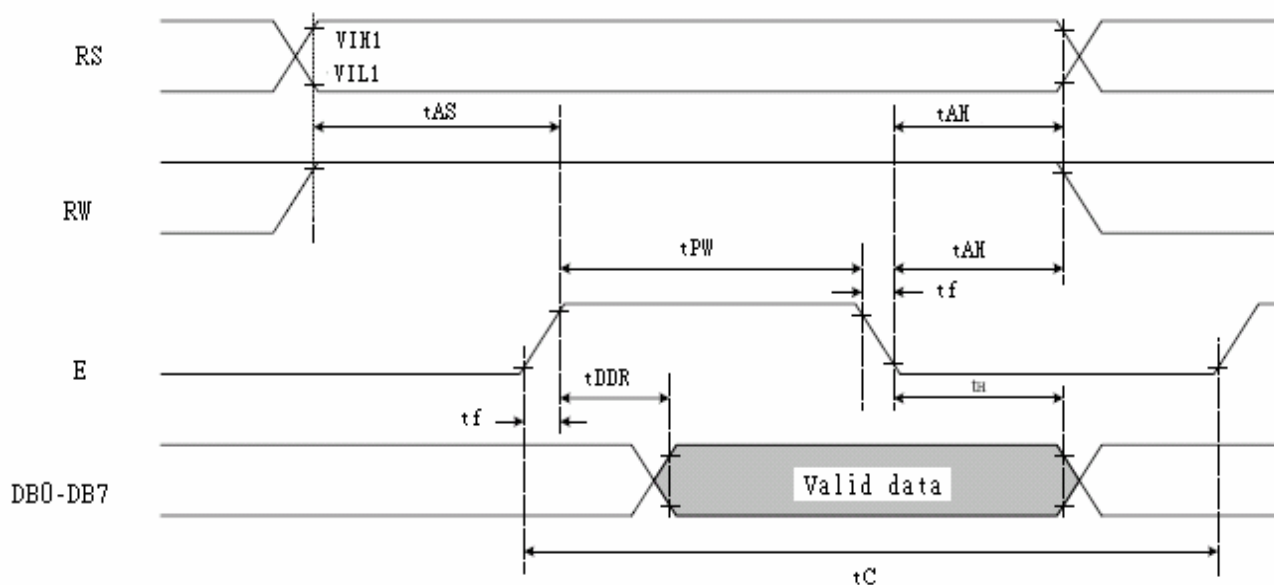


Ta=25°C, VDD=5.0V

| Item | Symbol | Min | Typ | Max | Unit |
|------------------------------------|---------------------------------|------|-----|-----|------|
| Enable cycle time | T _C | 1200 | — | — | ns |
| Enable pulse width | T _{PW} | 140 | — | — | ns |
| Enable rise/fall time | T _R , T _F | — | — | 25 | ns |
| Address set-up time (RS, R/W to E) | t _{AS} | 0 | — | — | ns |
| Address hold time | t _{AH} | 10 | — | — | ns |
| Data set-up time | t _{DSW} | 40 | — | — | ns |
| Data hold time | t _H | 10 | — | — | ns |

12.2 Read Operation

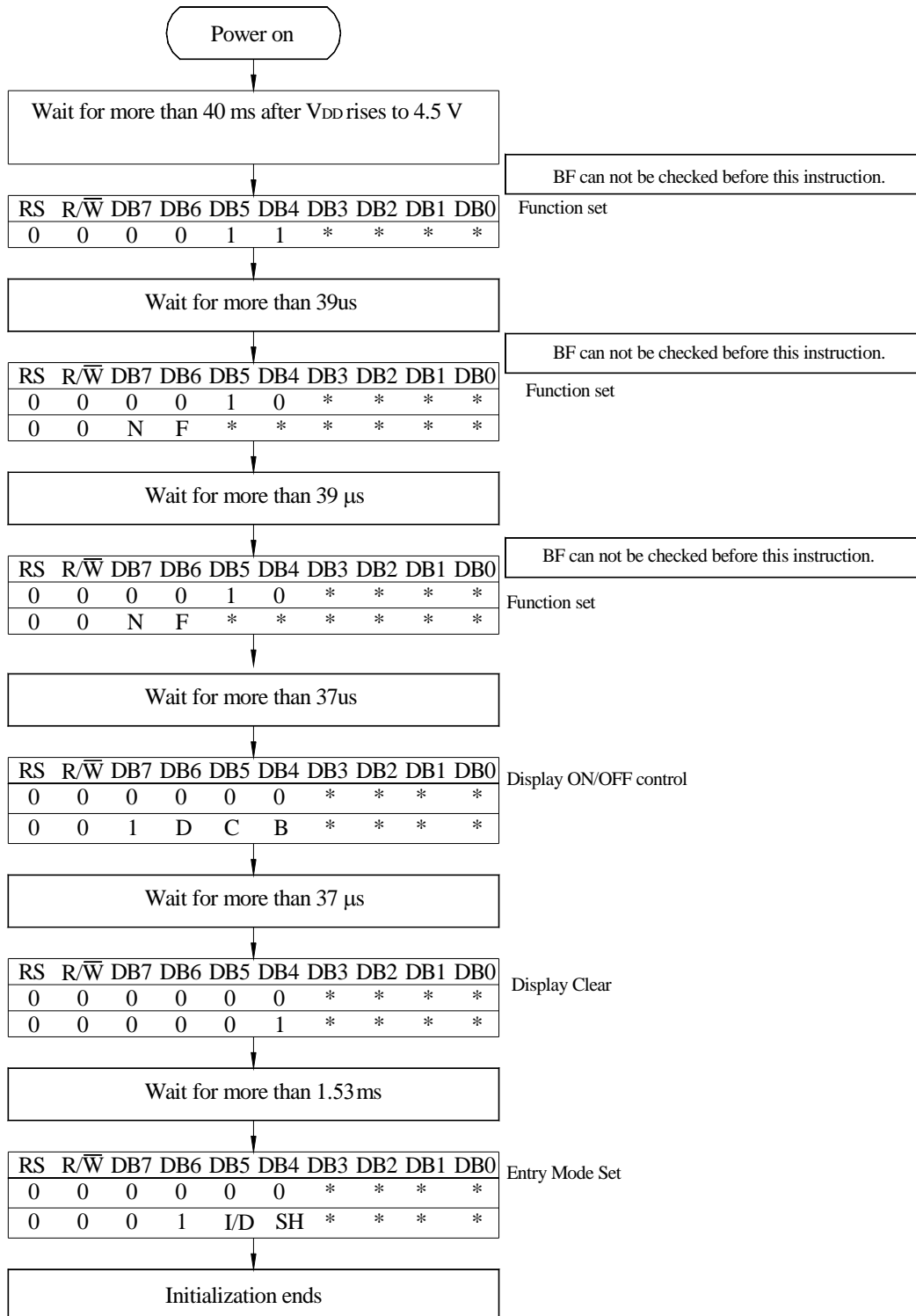
- Reading data from ST7066U



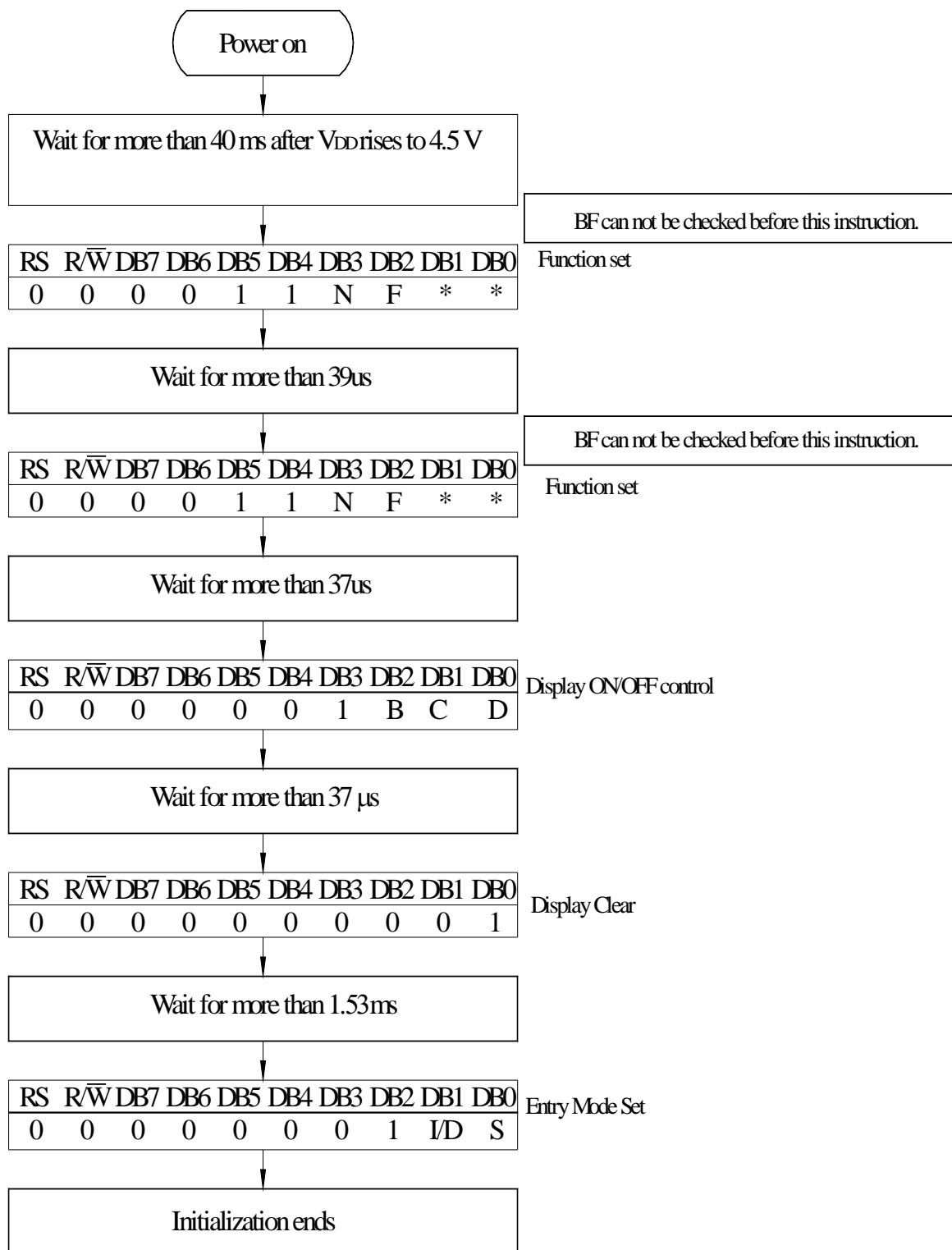
Ta=25°C, VDD=5V

| Item | Symbol | Min | Typ | Max | Unit |
|------------------------------------|---------------------------------|------|-----|-----|------|
| Enable cycle time | T _C | 1200 | — | — | ns |
| Enable pulse width (high level) | T _{PW} | 140 | — | — | ns |
| Enable rise/fall time | T _R , T _F | — | — | 25 | ns |
| Address set-up time (RS, R/W to E) | t _{AS} | 0 | — | — | ns |
| Address hold time | t _{AH} | 10 | — | — | ns |
| Data delay time | t _{DDR} | — | — | 100 | ns |
| Data hold time | t _H | 10 | — | — | ns |

13. Initializing of LCM



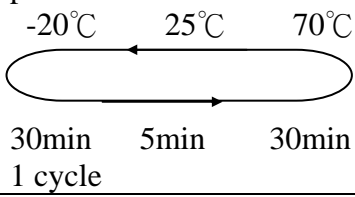
4-Bit Ineterface



8-Bit Ineterface

14. Reliability

Content of Reliability Test (wide temperature, -20°C~70°C)

| Environmental Test | | | |
|---|---|--|------|
| Test Item | Content of Test | Test Condition | Note |
| High Temperature storage | Endurance test applying the high storage temperature for a long time. | 80°C 200hrs | 2 |
| Low Temperature storage | Endurance test applying the high storage temperature for a long time. | -30°C 200hrs | 1,2 |
| High Temperature Operation | Endurance test applying the electric stress (Voltage & Current) and the thermal stress to the element for a long time. | 70°C 200hrs | — |
| Low Temperature Operation | Endurance test applying the electric stress under low temperature for a long time. | -20°C 200hrs | 1 |
| High Temperature/ Humidity Operation | The module should be allowed to stand at 60°C, 90%RH max For 96hrs under no-load condition excluding the polarizer, Then taking it out and drying it at normal temperature. | 60°C, 90%RH 96hrs | 1,2 |
| Thermal shock resistance | The sample should be allowed stand the following 10 cycles of operation  30min 5min 30min 1 cycle | -20°C/70°C 10 cycles | — |
| Vibration test | Endurance test applying the vibration during transportation and using. | Total fixed amplitude : 1.5mm Vibration Frequency : 10~55Hz One cycle 60 seconds to 3 directions of X, Y, Z for Each 15 minutes | 3 |
| Static electricity test | Endurance test applying the electric stress to the terminal. | VS=800V, RS=1.5kΩ CS=100pF 1 time | — |

Note1: No dew condensation to be observed.

Note2: The function test shall be conducted after 4 hours storage at the normal Temperature and humidity after remove from the test chamber.

Note3: Vibration test will be conducted to the product itself without putting it in a container.