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The LCD(M) Specialist

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PART NO. : WC0802D
-SFYLYHTC06

FOR MESSRS. : _____

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ACCEPTED BY: _____

PROPOSED BY: _____

RECORD OF REVISION

| DATE | PAGE | SUMMARY |
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| | | |

3. General specifications

3.1 General specifications

PLEASE REFER TO:

“CUSTOMER ACCEPTANCE STANDARD SPECIFICATIONS (MS-10-10000)”.

3.2 Quality Assurance and Warranty

PLEASE REFER TO:

“QUALITY ASSURANCE MANUL (MS-10-10001)”.

3.3 This individual specification is prior to general specifications

4. Mechanical data

- Display format: 8 characters x 2 line
- LCD type: STN Positive, Yellow-green, Transflective
- Backlight color: LED, Yellow-Green
- Viewing angle: 6 : 00
- Data transfer: 8Bit Parallel
- LCD controller: S6A0069
- Module size: 40 x 35.4 mm
- View area: 30.4x13.9 mm
- Dot size: 0.60 x 0.60 mm
- Driving method: 1/16 duty, 1/5 bias

5. Absolute maximum ratings

5.1 Electrical absolute maximum ratings

| <i>I T E M</i> | <i>SYMBOL</i> | <i>MIN.</i> | <i>MAX.</i> | <i>UNIT</i> | <i>COMMENT</i> |
|--------------------------------|----------------------------------|-------------|-------------|------------------|----------------|
| POWER SUPPLY FOR LOGIC | V _{DD} -V _{SS} | -0.3 | 6 | V | ----- |
| STATIC ELECTRICITY | ----- | ----- | ----- | V | -- |
| POWER SUPPLY FOR BACKLIGHT | V _S | 0 | 4.3 | V _{rms} | ----- |
| | f _{FL} | ----- | ----- | KHz | ----- |
| STARTING VOLTAGE FOR BACKLIGHT | ----- | ----- | ----- | V _{rms} | Ta = 25°C |
| | ----- | ----- | ----- | V _{rms} | Ta = 25°C |

5.2 Environmental absolute maximum ratings

| <i>I T E M</i> | <i>OPERATING</i> | | <i>STORAGE</i> | | <i>COMMENT</i> |
|-----------------------|------------------|-------------|----------------|-------------|---|
| | <i>MIN.</i> | <i>MAX.</i> | <i>MIN.</i> | <i>MAX.</i> | |
| AMBIENT TEMPERATURE | -20°C | 70°C | -30°C | 80°C | ----- |
| HUMIDITY | NOTE (2) | | NOTE (2) | | NO CONDENSATION |
| VIBRATION NOTE (3) | ----- | 0.5G | ----- | 2G | 10~300Hz XYZ DIRECTIONS 1 Hr EACH |
| SHOCK NOTE (3) | ----- | 3G | ----- | 5G | 10 msec XYZ DIRECTIONS 1 TIME EACH |
| CORROSIVE GAS | NOT ACCEPTABLE | | NOT ACCEPTABLE | | ----- |

NOTE (2): Ta ≅ 70°C: 75% RH MAX.

Ta > 70°C: ABSOLUTE HUMIDITY MUST BE LOWER THAN THE HUMIDITY OF 75% RH AT 70°C.

NOTE (3): 1G = 9.8 m/s²

6. Electrical characteristics

Ta = 25°C VDD = 5.0 V

| <i>I T E M</i> | <i>SYMBOL</i> | <i>CONDITION</i> | <i>MIN.</i> | <i>TYP.</i> | <i>MAX.</i> | <i>UNIT</i> |
|------------------------------------|---------------------|---|-------------|-------------|---------------------|-------------|
| Power supply voltage for circuit | V _{DD-VSS} | ----- | 4.75 | 5.0 | 5.25 | V |
| Power supply voltage for LCD drive | V _{DD-V0} | ----- | ----- | 4.8 | ----- | V |
| Data input voltage | V _{IH} | H LEVEL | 2.4 | ----- | V _{DD+0.3} | V |
| | V _{IL} | L LEVEL | -0.3 | ----- | 0.2V _{DD} | V |
| LCD display duty ratio | DUTY | ----- | ----- | 1/16 | ----- | ----- |
| LED BACKLIGHT | Ifp | I mse0 plus 10% Dutg cycle | | --- | | mA |
| | | Operating voltage | ----- | 4.1 | ---- | V |
| | | Forward current | | 50 | | mA |
| LED Lifetime | ----- | V _{FL} =4.1Vrms f _{FL} = KHZ | ----- | 100,000 | ----- | Hr |

7. Optical characteristics

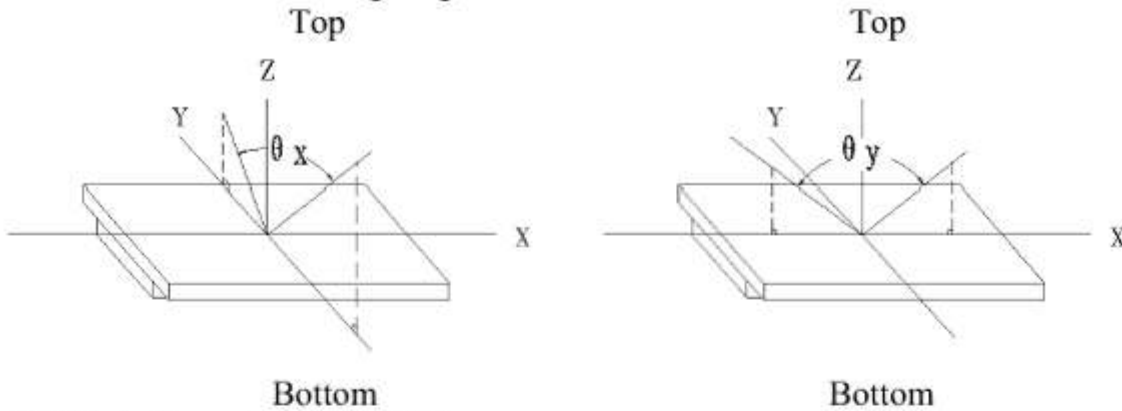
Ta = 25°C VDD-V0 = 4.8V

| <i>I T E M</i> | <i>SYMBOL</i> | <i>CONDITION</i> | <i>MIN.</i> | <i>TYP.</i> | <i>MAX.</i> | <i>UNIT</i> | <i>NOTE</i> |
|--|---------------|---|-------------|-------------|-------------|-------------------|-------------|
| Viewing angle | Φ2-Φ1 | K ≥ 2.0 | -35 | ---- | 20 | deg. | 1 |
| Contrast ratio | K | Φ = 10° θ = 0° | 4.0 | ---- | ----- | ----- | 1 |
| Response time (at 25°C) | tr (rise) | Φ = 10° θ = 0° | ----- | ---- | 250 | ms | 1 |
| | tf (fall) | Φ = 10° θ = 0° | ----- | ---- | 250 | ms | 1 |
| The brightness of backlighting source | B | V _{FL} =4.1Vrms f _{FL} = KHZ | ----- | 150 | ----- | cd/m ² | 2 |

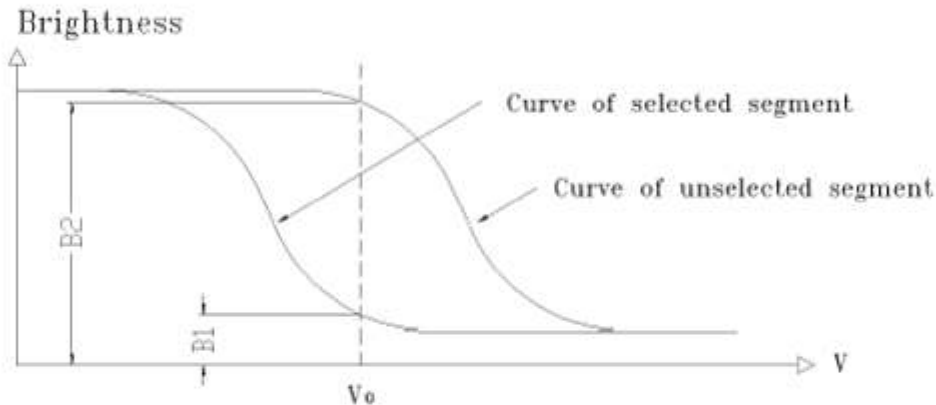
NOTE (1): SEE CUSTOMER ACCEPTANCE STANDARD SPECIFICATION FOR DEFINITION OF OPTICAL CHARACTERISTICS

NOTE (2): UNDER NORMAL TEMPERATURE AND HUMIDITY IN A DARK ROOM

7.2.1 Definition of Viewing Angle



7.2.2 Definition of Contrast Ratio

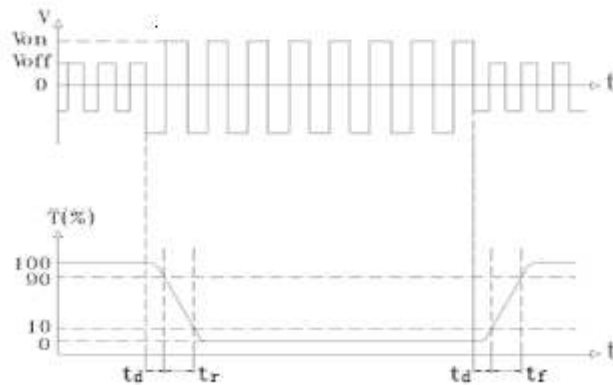


$$\text{Contrast Ratio} = B2/B1 = \frac{\text{unselected state brightness}}{\text{selected state brightness}}$$

Measuring Conditions:

- 1) Ambient Temperature: 25°C ;
- 2) Frame frequency: 64Hz

7.2.3 Definition of Response time



Turn on time: $t_{on} = t_d + t_r$ Turn off time: $t_{off} = t_d + t_r$

Measuring Condition:

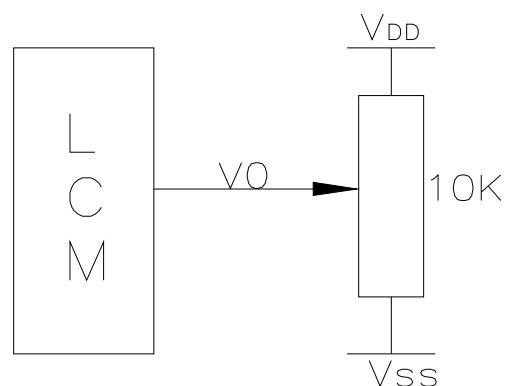
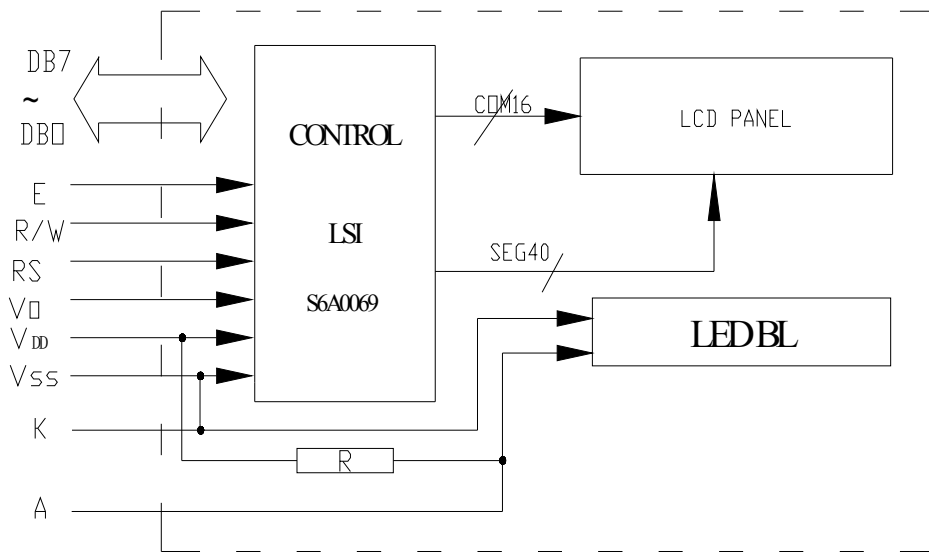
- 1) Operating Voltage: 5.0V
- 2) Frame frequency: 64Hz

8.1 Interface

Pin Assignment

| PIN NO. | Symbol | Level | Function |
|---------|--------|-----------|---|
| 1 | Vss | 0V | Ground |
| 2 | Vdd | 5.0V | Power Supply for LCD and LED Backlight(+) |
| 3 | V0 | ---- | Contrast Adjust |
| 4 | RS | H/L | Register select signal |
| 5 | RW | H/L | Data read / write |
| 6 | E | H/L | 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 |
| A | + | 4.1V/50mA | Power Supply for LED Backlight(+) |
| K | - | 0V | Power Supply for LED Backlight(-) |

9. Block diagram

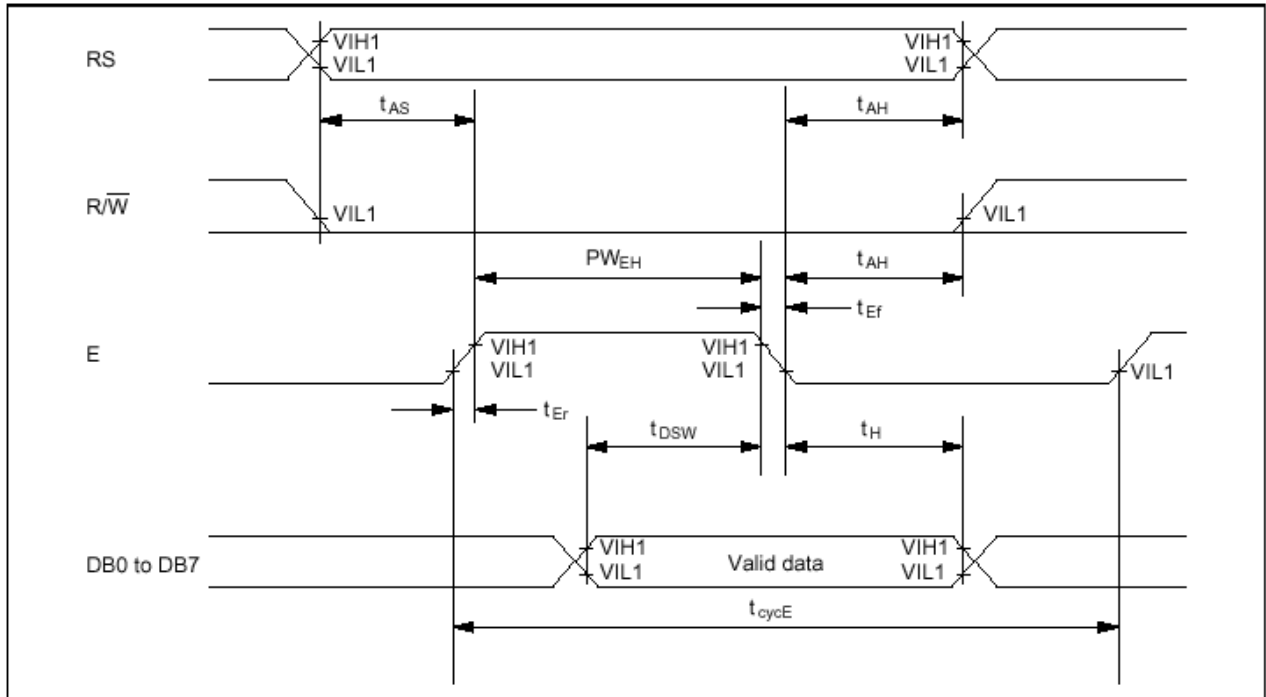


10. Interface Timing Chart

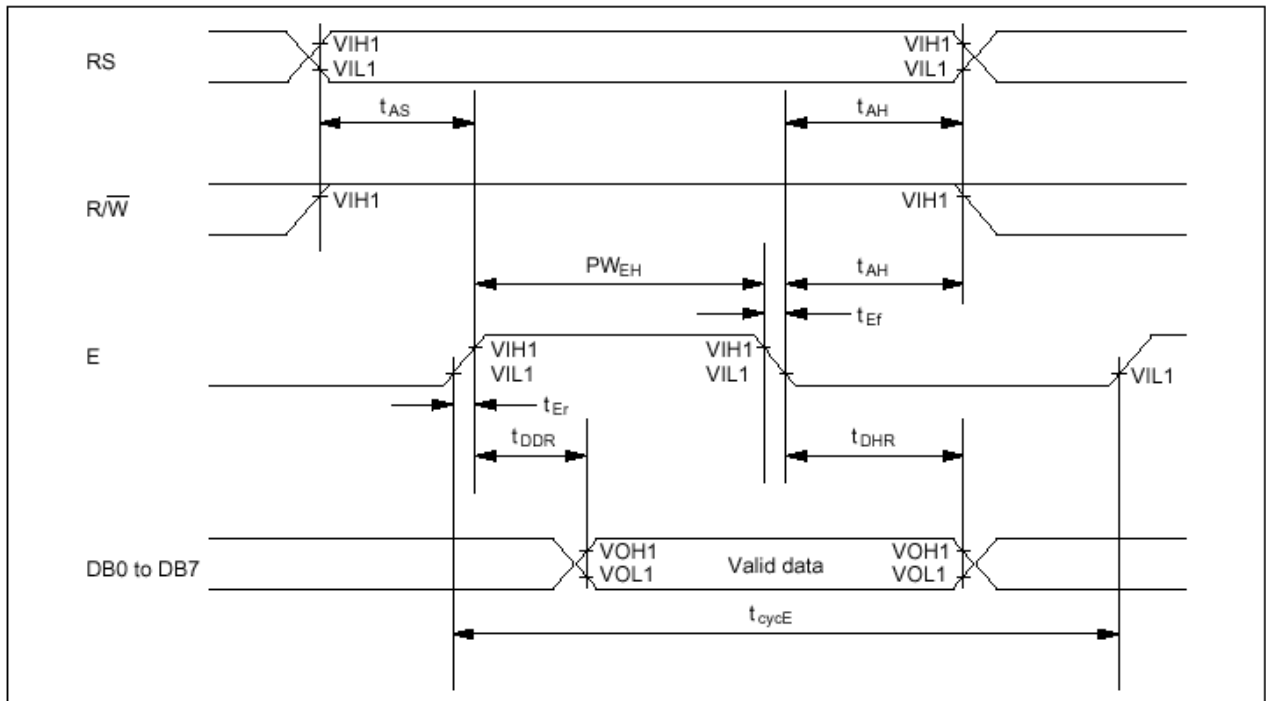
AC Characteristics ($V_{DD}=4.5V\sim 5.5V, T_a=-30\sim +85^{\circ}C$)

| Mode | Characteristic | Symbol | Min. | Typ. | Max. | Unit |
|--------------------------------|---------------------------|-------------|------|------|------|------|
| Write Mode (Refer to Fig-6) | E Cycle Time | t_c | 500 | - | - | ns |
| | E Rise / Fall Time | t_{R,t_F} | - | - | 20 | |
| | E Pulse Width (High, Low) | t_w | 230 | - | - | |
| | R/W and RS Setup Time | t_{su1} | 40 | - | - | |
| | R/W and RS Hold Time | t_{H1} | 10 | - | - | |
| | Data Setup Time | t_{su2} | 80 | - | - | |
| | Data Hold Time | t_{H2} | 10 | - | - | |
| Read Mode (Refer to Fig-7) | E Cycle Time | t_c | 500 | - | - | ns |
| | E Rise / Fall Time | t_{R,t_F} | - | - | 20 | |
| | E Pulse Width (High, Low) | t_w | 230 | - | - | |
| | R/W and RS Setup Time | t_{su} | 40 | - | - | |
| | R/W and RS Hold Time | t_H | 10 | - | - | |
| | Data Output Delay Time | t_D | - | - | 120 | |
| | Data Hold Time | t_{DH} | 5 | - | - | |

Timing Characteristics



Write Operation



Read Operation

11. Instruction Code

Instruction Table

| Instruction | Instruction Code | | | | | | | | | | Description | Execution time (fosc= 270 kHz) | |
|----------------------------|------------------|-----|-----|-----|-----|-----|-----|-----|-----|-----|--|--|-------|
| | 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 and set DDRAM address to "00H" from AC | 1.53 ms | |
| Return Home | 0 | 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. | 1.53 ms | |
| Entry Mode Set | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | I/D | SH | Assign cursor moving direction and enable the shift of entire display. | 39 μs |
| Display ON/OFF Control | 0 | 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 μs |
| Cursor or Display Shift | 0 | 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 μs |
| Function Set | 0 | 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:5×11dots/5×8 dots) | 39 μs |
| Set CGRAM Address | 0 | 0 | 0 | 1 | AC5 | AC4 | AC3 | AC2 | AC1 | AC0 | | Set CGRAM address in address counter. | 39 μs |
| Set DDRAM Address | 0 | 0 | 1 | AC6 | AC5 | AC4 | AC3 | AC2 | AC1 | AC0 | | Set DDRAM address in address counter. | 39 μs |
| 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). | 43 μs |
| Read Data from RAM | 1 | 1 | D7 | D6 | D5 | D4 | D3 | D2 | D1 | D0 | | Read data from internal RAM (DDRAM/CGRAM). | 43 μs |

* "-": don't care

NOTE: When an MPU program with checking the Busy Flag(DB7) is made, it must be necessary 1/2Fosc is necessary for executing the next instruction by the falling edge of the 'E' signal after the Busy Flag (DB7) goes to "Low".

8-bit interface mode (Condition: fosc = 270KHZ)

Power on

Wait for more than 30 ms after VDD rises to 4.5 v

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

Wait for more than 39 μs

| 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 |

Wait for more than 39 μs

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

Wait for more than 1.53 ms

| 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 |

Initialization end

| | | |
|---|---|-------------|
| 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.Character generator ROM

| Lower 4 Bits \ Upper 4 Bits | 0000 | 0010 | 0011 | 0100 | 0101 | 0110 | 0111 | 1010 | 1011 | 1100 | 1101 | 1110 | 1111 |
|-----------------------------|------------|------|------|------|------|------|------|------|------|------|------|------|------|
| xxxx0000 | CG RAM (1) | | Ø | Q | P | ` | P | | - | タ | ミ | Ω | ρ |
| xxxx0001 | (2) | ! | 1 | A | Q | a | q | 。 | ア | チ | △ | ä | g |
| xxxx0010 | (3) | " | 2 | B | R | b | r | 「 | イ | ツ | × | ß | θ |
| xxxx0011 | (4) | # | 3 | C | S | c | s | 」 | ウ | テ | モ | ε | ω |
| xxxx0100 | (5) | \$ | 4 | D | T | d | t | 、 | イ | ト | ト | μ | Ω |
| xxxx0101 | (6) | % | 5 | E | U | e | u | ・ | オ | ナ | 1 | ε | ü |
| xxxx0110 | (7) | & | 6 | F | V | f | v | ヲ | カ | ニ | ヨ | ρ | Σ |
| xxxx0111 | (8) | ' | 7 | G | W | g | w | ア | キ | ヌ | ラ | g | π |
| xxxx1000 | (1) | (| 8 | H | X | h | x | イ | ク | ネ | リ | γ | × |
| xxxx1001 | (2) |) | 9 | I | Y | i | y | ウ | ケ | ル | | ˆ | y |
| xxxx1010 | (3) | * | : | J | Z | j | z | エ | コ | ン | レ | j | ¥ |
| xxxx1011 | (4) | + | ; | K | C | k | c | オ | サ | ヒ | ロ | * | 万 |
| xxxx1100 | (5) | , | < | L | ¥ | l | l | ヤ | シ | フ | ワ | φ | 円 |
| xxxx1101 | (6) | - | = | M | J | m | n | ユ | ズ | ン | シ | も | ÷ |
| xxxx1110 | (7) | . | > | N | ^ | n | → | ヨ | セ | ホ | ° | ñ | |
| xxxx1111 | (8) | / | ? | O | _ | o | ← | ッ | ソ | マ | ° | ö | ■ |