

LMS0192B

LCD Module User Manual

Shenzhen TOPWAY Technology Co., Ltd.

| Rev. | Descriptions | Release Date |
|------|-------------------|--------------|
| 0.1 | Prelimiay release | 2004-09-24 |
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1. Basic Specifications

1.1 Display Specifications

- 1) LCD Display Mode : FSTN, Positive, Transflective
- 2) Display Color : Display Data = "1" : Dark Gray (*1)
: Display Data = "0" : Light Gray (*2)
- 3) Viewing Angle : 6H
- 4) Driving Method : 1/65 duty, 1/9 bias
- 5) Back Light : YG LED backlight

Note:

*1. Color tone may slightly change by Temperature and Driving Condition.

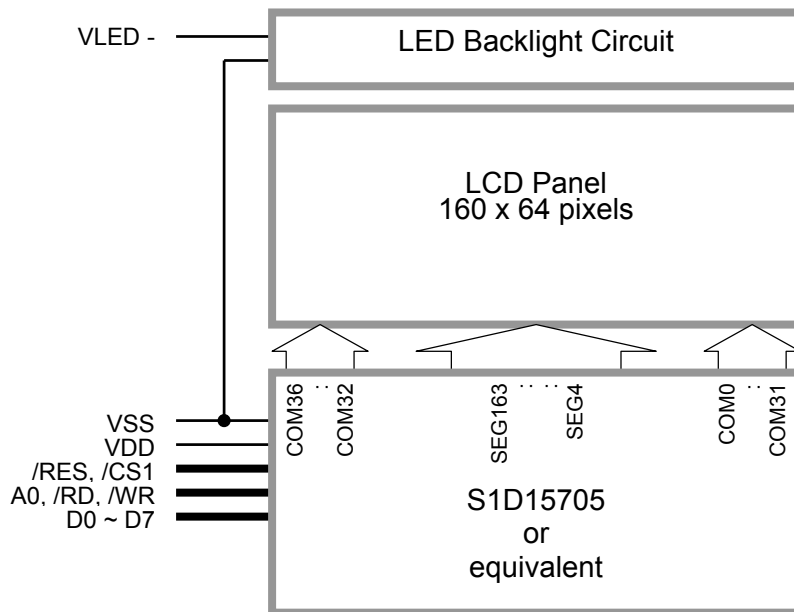
*2. The Color is defined as the inactive / background color

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1.2 Mechanical Specifications

- 1) Outline Dimension : 79.0 x 42.3 x 6.3MAX
(See attached Outline Drawing for details)

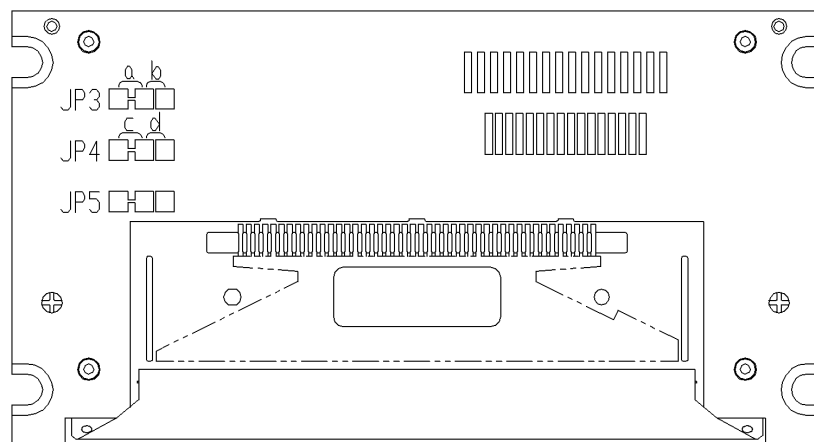
1.3 Block Diagram



1.4 Terminal Functions

| Pin No. | Pin Name | I/O | Descriptions |
|--------------|---------------|-------|--|
| 1 | VLED- | Power | Backlight Negative Power Supply |
| 2 | /CS1 | Input | Chip Select: /CS1=LOW : Data IO is enabled |
| 3 | /RES | Input | Reset: /RES=LOW: Initialization is executed /RES=HIGH: Normal |
| 4 | A0 | Input | Control / Display data flag: A0=HIGH: data on D0 to D7 is display data A0=LOW: data on D0 to D7 is control data |
| 5 | /WR(R/W) | Input | In 8080 interface mode: Write enable input, active LOW In 6800 interface mode: R/W=HIGH: Read mode selected R/W=LOW: Write mode selected |
| 6 | /RD(E) | Input | In 8080 interface mode: Read enable input, active LOW In 6800 interface mode: Enable Clock Signal, active HIGH |
| 7 : 12 | D0 : D5 | I/O | Bi-directional data bus: In parallel interface mode: 8-bit data I/O In serial interface mode: D7=SI(Serial data input), D6=SCL(Serial clock input) |
| 13 | D6(SCL) | | |
| 14 | D7(SI) | | |
| 15 | VDD | Power | Positive Power Supply |
| 16 | VSS | Power | 0V Supply, Ground (0V) |

1.5 Jumpers Functions



Back side of LCD module

| Jumper | Function | Descriptions | | | | | | | | | | | | | | | | | | |
|--------------|----------------|--|----------|--------------|----------------|------|--------------|--------------|--------------|------|----|-------|----------|---|------------|------|----|---------|------------|----------|
| JP3 | 8080/6800 Mode | Microprocessor interface mode select a=short, b=open: 8080 series microprocessor interface (default) a=open, b=short: 6800 series microprocessor interface | | | | | | | | | | | | | | | | | | |
| JP4 | P/S Mode | Serial / Parallel interface mode select c=close, d=open: Parallel interface selected (default) c=open, d=close: Serial interface selected <table border="1" style="width: 100%; border-collapse: collapse;"> <thead> <tr> <th>P/S mode</th> <th>Chip Select</th> <th>Data / Command</th> <th>Data</th> <th>Read / Write</th> <th>Serial Clock</th> </tr> </thead> <tbody> <tr> <td>Parallel I/F</td> <td>/CS1</td> <td>A0</td> <td>D0-D7</td> <td>/RD, /WR</td> <td>-</td> </tr> <tr> <td>Serial I/F</td> <td>/CS1</td> <td>A0</td> <td>SI (D7)</td> <td>Write only</td> <td>SCL (D6)</td> </tr> </tbody> </table> <p>In serial interface mode: No data can be read from RAM D0 to D5 are HZ, /RD and /WR must be fixed HIGH or LOW</p> | P/S mode | Chip Select | Data / Command | Data | Read / Write | Serial Clock | Parallel I/F | /CS1 | A0 | D0-D7 | /RD, /WR | - | Serial I/F | /CS1 | A0 | SI (D7) | Write only | SCL (D6) |
| P/S mode | Chip Select | Data / Command | Data | Read / Write | Serial Clock | | | | | | | | | | | | | | | |
| Parallel I/F | /CS1 | A0 | D0-D7 | /RD, /WR | - | | | | | | | | | | | | | | | |
| Serial I/F | /CS1 | A0 | SI (D7) | Write only | SCL (D6) | | | | | | | | | | | | | | | |
| JP5 | Reserved | - | | | | | | | | | | | | | | | | | | |

Cautions:

When setting the Jumper, take extreme care at any unexpected short circuit or damage on the LCD module.

2. Absolute Maximum Ratings

| Items | Symbol | Min. | Max. | Unit | Condition |
|-----------------------|----------|------|--------------|------|-----------------|
| Supply Voltage | V_{DD} | -0.3 | +6.0 | V | $V_{SS} = 0V$ |
| Input Voltage | V_{IN} | -0.3 | $V_{DD}+0.3$ | V | $V_{SS} = 0V$ |
| Operating Temperature | T_{OP} | -20 | +70 | °C | No Condensation |
| Storage Temperature | T_{ST} | -20 | +80 | °C | No Condensation |

Cautions:

Any Stresses exceeding the Absolute Maximum Ratings may cause substantial damage to the device. Functional operation of this device at other conditions beyond those listed in the specification is not implied and prolonged exposure to extreme conditions may affect device reliability.

3. Electrical Characteristics

3.1 DC Characteristics

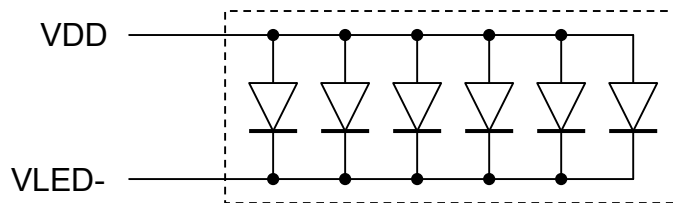
$V_{SS}=0V, V_{DD}=5.0V, T_{OP}=25^{\circ}C$

| Items | Symbol | MIN. | TYP. | MAX. | Unit | Condition / Application Pin |
|---------------------|-----------|---------------------|------|---------------------|---------|---------------------------------|
| Operating Voltage | V_{DD} | 4.5 | 5.0 | 5.5 | V | VDD |
| Input High Voltage | V_{IH} | $0.8 \times V_{DD}$ | - | V_{DD} | V | /RES, /CS1, A0, /WR, /RD, D0~D7 |
| Input Low Voltage | V_{IL} | 0 | - | $0.2 \times V_{DD}$ | V | |
| Output High Voltage | V_{OH} | $0.7 \times V_{DD}$ | - | V_{DD} | V | $I_{OH}=-0.3mA, D0\sim D7$ |
| Output Low Voltage | V_{OL} | 0 | - | $0.3 \times V_{DD}$ | V | $I_{OL}=0.3mA, D0\sim D7$ |
| Operating Current | I_{DD} | - | 0.4 | 1.8 | mA | VDD |
| Sleep Mode Current | I_{DDs} | - | - | 1.0 | μA | VDD |

3.2 LED Backlight Circuit Characteristics

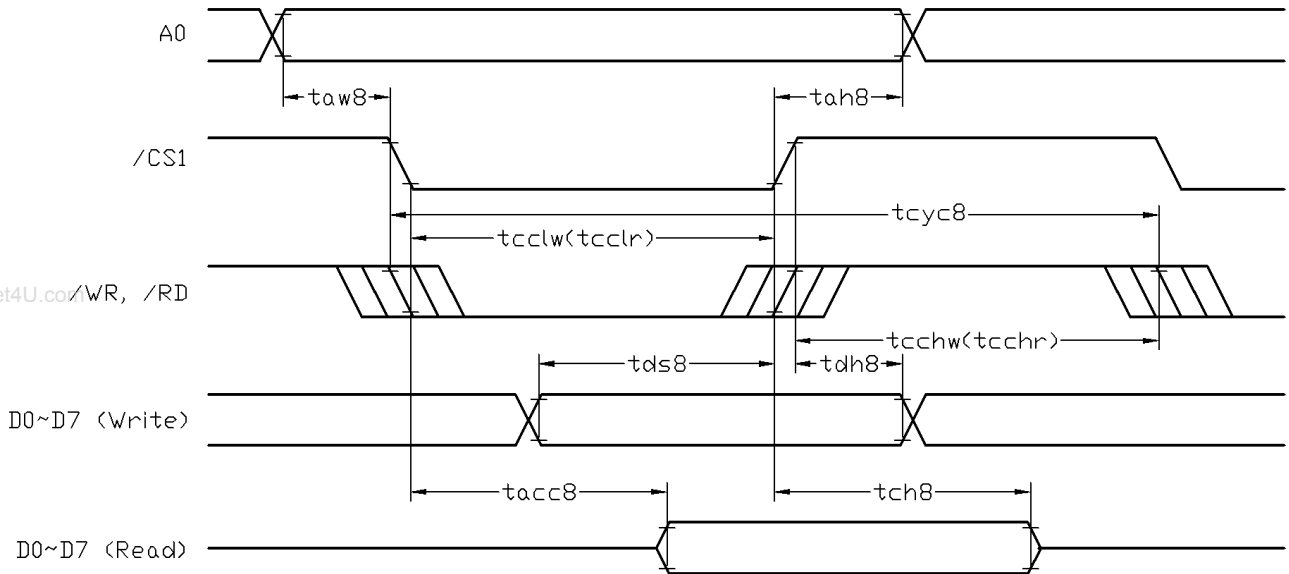
$V_{DD}=5.0V, I_{f_{VLED-}}=60mA, T_{OP}=25^{\circ}C$

| Items | Symbol | MIN. | TYP. | MAX. | Unit | Applicable Pin |
|-----------------|-----------------|------|------|------|------|----------------|
| Forward Voltage | $V_{f_{VLED-}}$ | - | 3.0 | - | V | VLED- |
| Forward Current | $I_{f_{VLED-}}$ | - | - | 90 | mA | VLED- |



3.3 AC Characteristics

3.3.1 8080 Mode System Bus Timing



$V_{SS}=0V, V_{DD}=5.0V, T_{OP}=25^{\circ}C$

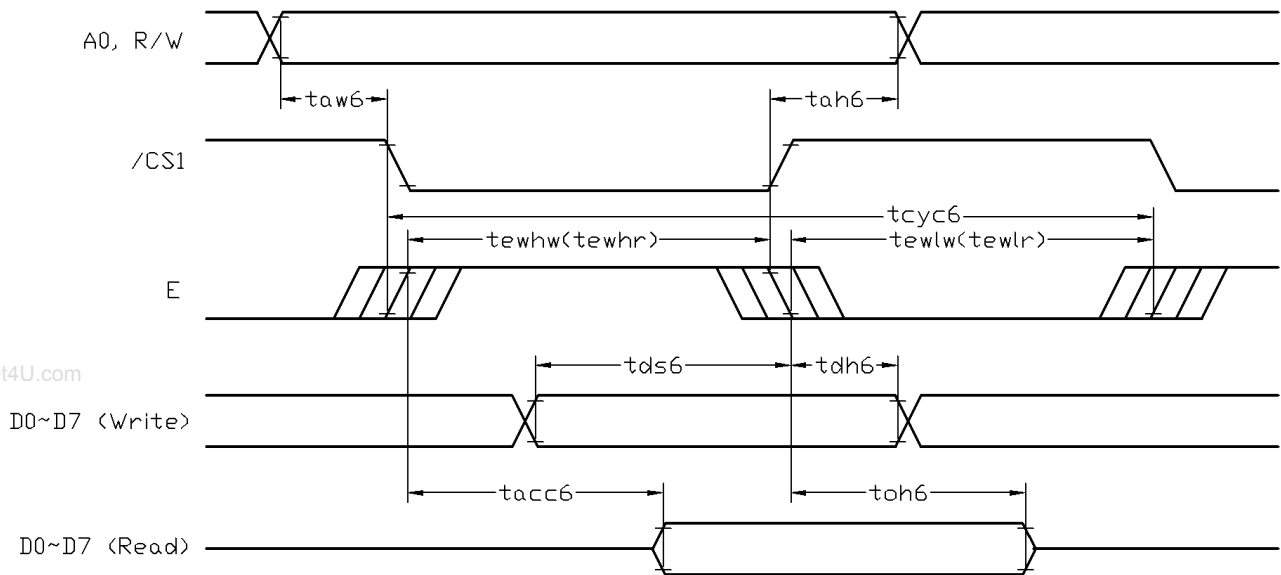
| Item | Symbol | MIN. | TYP. | MAX. | Unit |
|--------------------------------|--------|------|------|------|------|
| System cycle time | tcyc8 | 320 | - | - | ns |
| Address setup time (A0) | taw8 | 10 | - | - | ns |
| Address hold time (A0) | tah8 | 10 | - | - | ns |
| Control LOW pulse width (/WR) | tcclw | 40 | - | - | ns |
| Control LOW pulse width (/RD) | tcclr | 90 | - | - | ns |
| Control HIGH pulse width (/WR) | tcchw | 40 | - | - | ns |
| Control HIGH pulse width (/RD) | tcchr | 40 | - | - | ns |
| Data setup time | tds8 | 40 | - | - | ns |
| Data hold time | tdh8 | 13 | - | - | ns |
| /RD access time (*2) | tacc8 | - | - | 90 | ns |
| Output disable time (*2) | tch8 | - | - | 65 | ns |

Note:

*1. Input signal rise/fall time should be less than 12ns

*2. CL=100pF

3.3.2 6800 Mode System Bus Timing



$V_{SS}=0V, V_{DD}=5.0V, T_{OP}=25^{\circ}C$

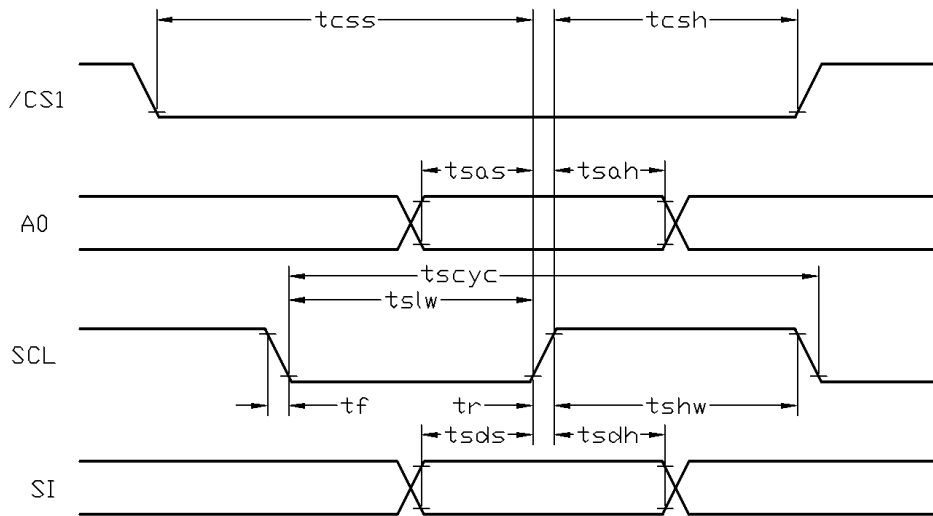
| Item | Symbol | MIN. | TYP. | MAX. | Unit |
|---------------------------------|--------|------|------|------|------|
| System cycle time | tcyc6 | 320 | - | - | ns |
| Address setup time | taw6 | 10 | - | - | ns |
| Address hold time | tah6 | 10 | - | - | ns |
| Enable High pulse width (Read) | tewhr | 90 | - | - | ns |
| Enable High pulse width (Write) | tewhw | 40 | - | - | ns |
| Enable Low pulse width (Read) | tewlr | 40 | - | - | ns |
| Enable Low pulse width (Write) | tewlw | 40 | - | - | ns |
| Data setup time | tds6 | 40 | - | - | ns |
| Data hold time | tdh6 | 13 | - | - | ns |
| Output disable time (*2) | toh6 | - | - | 65 | ns |
| Access time (*2) | tacc6 | - | - | 90 | ns |

Note:

*1. Input signal rise/fall time should be less than 12ns

*2. CL=100pF

3.3.3 Serial Interface Timing



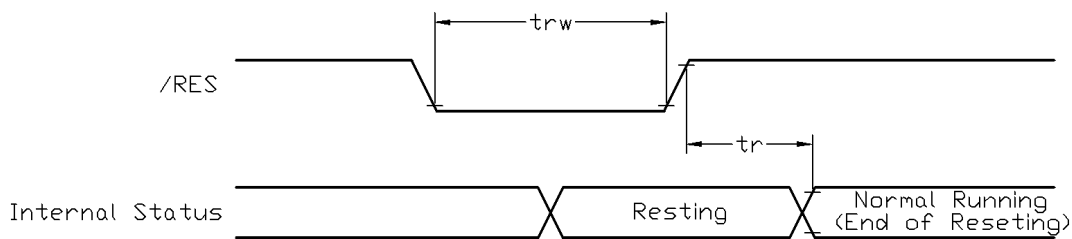
$V_{SS}=0V, V_{DD}=5.0V, T_{OP}=25^{\circ}C$

| Item | Symbol | MIN. | TYP. | MAX. | Unit |
|-------------------------------|--------|------|------|------|------|
| Serial clock cycle | tscyc | 250 | - | - | ns |
| Serial clock High pulse width | tshw | 100 | - | - | ns |
| Serial clock Low pulse width | tslw | 100 | - | - | ns |
| Address setup time | tsas | 65 | - | - | ns |
| Address hold time | tsah | 130 | - | - | ns |
| Data setup time | tsds | 65 | - | - | ns |
| Data hold time | tsdh | 65 | - | - | ns |
| CS serial clock time | tcss | 130 | - | - | ns |
| CS serial clock time | tcsh | 130 | - | - | ns |

Note:

*1. Input signal rise/fall time should be less than 12ns

3.3.4 Reset Timing



$V_{SS}=0V, V_{DD}=5.0V, T_{OP}=25^{\circ}C$

| Item | Symbol | MIN. | TYP. | MAX. | Unit |
|-----------------------|--------|------|------|------|---------|
| Reset time | tr | - | - | 2 | μs |
| Reset LOW pulse width | trw | 2 | - | - | μs |

Note:

*1. Input signal rise/fall time should be less than 12ns

4. Function Specifications

4.1 Basic Setting

To drive the LCD module correctly and provide normally display, please use the following setting

- Built-in Oscillator Circuit=ON
- LCD Bias Set = 1/9
- ADC = 1 (reverse)
- COM Output State Selection = reverse
- Display Start Line = 0
- Display All Lighting ON/OFF = OFF (normal)
- Display Normal/Reverse = Normal
- Set Power Control Set:
voltage follower = ON, voltage booster = ON, voltage adjusting circuit = ON
- Display ON/OFF = ON

Note:

*1. These setting/commands should issue the LCD module while start up.

*2. See the Display Commands section for details.

4.2 Resetting the LCD module

The LCD module should be initialized by using /RES terminal.

While turning on the VDD and VSS power supply, maintain /RES terminal at LOW level. After the power supply stabilized, release the reset terminal (/RES=HIGH)

4.3 Display Memory Map

| Page address | data | LCD Display (front view) | |
|----------------|---------------|--------------------------|-----|
| 0 | D0 : D7 | | |
| 1 | D0 : D7 | | |
| 2 | D0 : D7 | | |
| 3 | D0 : D7 | | |
| 4 | D0 : D7 | | |
| 5 | D0 : D7 | | |
| 6 | D0 : D7 | | |
| 7 | D0 : D7 | | |
| Column Address | | 24h | C3h |

Note:

*1. ADC = 1 (reverse)

*2. COM Output State Selection = reverse

*3. Display Start Line = 0

4.4 Display Commands

| No. | Instructions | Code | | | | | | | | | | Function | | |
|-----|-----------------------------------|------|-----|-----|--------------|----|-----------------------|----|-----------------|--------------|--|---|---|---------------------------------------|
| | | A0 | /RD | /WR | D7 | D6 | D5 | D4 | D3 | D2 | D1 | | D0 | |
| 1 | Display ON/OFF | 0 | 1 | 0 | 1 | 0 | 1 | 0 | 1 | 1 | 1 | 0 | 1 | 0 = Turns off LCD 1 = Turns on LCD |
| 2 | Set Display Start Line | 0 | 1 | 0 | 0 | 1 | Display Start Address | | | | Specifyes display RAM location for first line of display | | | |
| 3 | Set Page Address | 0 | 1 | 0 | 1 | 0 | 1 | 1 | Page Address | | | Set the display RAM page address | | |
| 4 | Set Column Address (Upper-4-bits) | 0 | 1 | 0 | 0 | 0 | 0 | 1 | Col. Add. Upper | | | Set the upper-4-bit of column address counter | | |
| | Set Column Address (Lower-4-bits) | 0 | 1 | 0 | 0 | 0 | 0 | 0 | Col. Add. Lower | | | Set the lower-4-bit of column address counter | | |
| 5 | Read Status | 0 | 0 | 1 | Status | | | | 0 | 0 | 0 | 0 | Read the internal status D4=RESET, 1=resetting, 0=normal D5=Display ON/OFF, 1=off, 0=on D6=ADC Flag, D7=BUSY Flag, 1=busy, 0=ready | |
| 6 | Write Display Data | 1 | 1 | 0 | Display Data | | | | | | Write data into the display RAM | | | |
| 7 | Read Display Data | 1 | 0 | 1 | Display Data | | | | | | Read data form the display RAM | | | |
| 8 | ADC Select | 0 | 1 | 0 | 1 | 0 | 1 | 0 | 0 | 0 | 0 | 0 | 0 = Normal display 1 = flipped in x direction | |
| 9 | Normal/Reverse Display | 0 | 1 | 0 | 1 | 0 | 1 | 0 | 0 | 1 | 1 | 0 | 0 = Normal display 1 = Reverse display | |
| 10 | Display All ON | 0 | 1 | 0 | 1 | 0 | 1 | 0 | 0 | 1 | 0 | 0 | 0 = Normal display 1 = All-ON | |
| 11 | Set LCD Bias | 0 | 1 | 0 | 1 | 0 | 1 | 0 | 0 | 0 | 1 | 0 | Set the LCD driving voltage bias 0 = 1/9 BIAS 1 = 1/7 BIAS | |
| 12 | Read-Modify-Write | 0 | 1 | 0 | 1 | 1 | 1 | 0 | 0 | 0 | 0 | 0 | Enter the "Read-Modify-Write" mode column address counter will increase in each "Write Display Data", and will not increase in each "Read Display Data command" | |
| 13 | End | 0 | 1 | 0 | 1 | 1 | 1 | 0 | 1 | 1 | 1 | 0 | Clear the "Read-Modify-Write" mode | |
| 14 | Reset | 0 | 1 | 0 | 1 | 1 | 1 | 0 | 0 | 0 | 1 | 0 | Resets the LCD module | |
| 15 | COMMON Output Status Selection | 0 | 1 | 0 | 1 | 1 | 0 | 0 | 0 | 1 | * | * | Set the COM scanning direction 0 = Normal display 1 = flipped in y direction * = don't care terms | |
| 16 | Power Control Set | 0 | 1 | 0 | 0 | 0 | 1 | 0 | 1 | Power Status | | | Set the power circuit operation mode D0 = LCD Supply Voltage Follower D1 = LCD Supply Voltage Adjusting Circuit D2 = LCD Supply Voltage Booster (1=ON, 0=OFF) | |

4.5 Display Commands (continue)

| No. | Instructions | Code | | | | | | | | | | Function |
|-----|---|------|-----|-----|----|----|--------------------------|----|-----------------|---------------|--|---|
| | | A0 | /RD | /WR | D7 | D6 | D5 | D4 | D3 | D2 | D1 | |
| 17 | Set Internal Resistance Ratio for V5 adjustment | 0 | 1 | 0 | 0 | 0 | 1 | 0 | 0 | Ratio Setting | | Set the built-in resistor ratio (Rb/Ra) |
| 18 | Electronic Vol. mode | 0 | 1 | 0 | 1 | 0 | 0 | 0 | 0 | 0 | 1 | Turn on the Electronic Vol Mode |
| | Set Electronic Vol. Register | 0 | 1 | 0 | x | x | Electronic Control value | | | | Set Electronic Vol. Value (Display contrast value) | |
| 20 | Power Save | 0 | 1 | 0 | 1 | 0 | 1 | 0 | 1 | 0 | 0 | Moves to the power save state: 0 = stand-by 1 = sleep |
| 21 | Power Save Reset | 0 | 1 | 0 | 1 | 1 | 1 | 0 | 0 | 0 | 1 | Reset power save |
| 22 | Set n-Line Reversal Drive Register | 0 | 1 | 0 | 0 | 0 | 1 | 1 | No. of Rev Line | | Sets the number of line reversal drive lines | |
| 23 | n-line Reversal Drive Reset | 0 | 1 | 0 | 1 | 1 | 1 | 0 | 0 | 1 | 0 | Resets the line reversal drive |
| 24 | Turn ON Built-in Oscillator Circuit | 0 | 1 | 0 | 1 | 0 | 1 | 0 | 1 | 0 | 1 | Start the operation of the built-in CR oscillator circuit |
| 25 | NOP | 0 | 1 | 0 | 1 | 1 | 1 | 0 | 0 | 0 | 1 | Non-operation command |
| 26 | Test | 0 | 1 | 0 | 1 | 1 | 1 | 1 | x | x | x | Test Command. Do not use. |

Note: *1. Do not use any other command not listed, or the system malfunction may result.
*2. For the details of the Display Commands, please refer to S1D15705 Series data sheet.

4.5.1 Power off the LCD Module

It recommends that enter sleep mode before power off the LCD module.

4.5.2 Refreshing The LCD Module

It recommends that the operating modes and display contents be refreshed periodically to prevent the effect of unexpected noise.

4.6 Basic Operating Sequence (example)

4.6.1 Initialization Sequence

| | Code Function | | | | | | | | | | Note | |
|---|---------------|--------------|----|----|----|----|----|----|----|-----|---|---|
| | A0 | D7 | D6 | D5 | D4 | D3 | D2 | D1 | D0 | hex | | |
| Turn on Power Supply VDD & VSS While maintaining /RES at LOW | - | - | - | - | - | - | - | - | - | - | - | - |
| Wait until power supply is stabilized | - | - | - | - | - | - | - | - | - | - | - | - |
| Release the /RES Reset Signal (/RES = HIGH) | - | - | - | - | - | - | - | - | - | - | - | See AC Characteristics section for timing details |
| Turn ON Built-in Oscillator Circuit | 0 | 1 | 0 | 1 | 0 | 1 | 0 | 1 | 1 | ABh | Turn on the Oscillator | |
| LCD bias = 1/9 | 0 | 1 | 0 | 1 | 0 | 0 | 0 | 1 | 0 | A2h | LCD panel Characteristic | |
| ADC = reverse | 0 | 1 | 0 | 1 | 0 | 0 | 0 | 0 | 1 | A1h | Flip on x-direction (SEG) | |
| COM Output Status = reverse | 0 | 1 | 1 | 0 | 0 | 1 | 0 | 0 | 0 | C8h | Flip on y-direction (COM) | |
| Display Start Line=0 | 0 | 0 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 40h | i.e. Display RAM "page 0 - D0" Matched to top line of the LCD | |
| Power Control LCD Supply Voltage Follower = ON LCD Supply Voltage Adjusting Circuit = ON LCD Supply Voltage Booster = ON | 0 | 0 | 0 | 1 | 0 | 1 | 1 | 1 | 1 | 2Fh | Turn on all the internal power circuit for driving the LCD normally | |
| Set Internal Resistance Ratio for V5 adjustment | 0 | 0 | 0 | 1 | 0 | 0 | 1 | 0 | 1 | 25h | Set the built-in resistor ratio to middle | |
| Set Electronic Vol. mode Set Electronic Vol. Register | 0 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 81h | Set to the middle of the range It may be adjusted for achieving the best display contrast | |
| | 0 | 0 | 0 | 0 | 1 | 0 | 0 | 1 | 1 | 13h | | |
| Display ON | 0 | 1 | 0 | 1 | 0 | 1 | 1 | 1 | 1 | AFh | Turn on the LCD display | |
| Set Page Address = 0 | 0 | 1 | 0 | 1 | 1 | 0 | 0 | 0 | 0 | B0h | Specify the Display Data RAM page address to 00h | |
| Set Column Address (Upper-4bit=0) Set Column High (Lower-4bit=0) | 0 | 0 | 0 | 0 | 1 | 0 | 0 | 0 | 0 | 10h | Specify the Display Data RAM column address to 00h | |
| | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 00h | | |
| Write Display Data | 1 | Display Data | | | | | | | | | Write data to Display Data RAM. After write, the internal Column Address Counter will be increased by 1 automatically | |
| Write Other Display Data ... | | | | | | | | | | | | |

5. Design and Handling Precaution

1. The LCD panel is made by glass. Any mechanical shock (eg. dropping from high place) will damage the LCD module.
2. Do not add excessive force on the surface of the display, which may cause the Display color change abnormally.
3. The polarizer on the LCD is easily get scratched. If possible, do not remove the LCD protective film until the last step of installation.
4. Never attempt to disassemble or rework the LCD module.
5. Only Clean the LCD with Isopropyl Alcohol or Ethyl Alcohol. Other solvents (eg. water) may damage the LCD.
6. When mounting the LCD module, make sure that it is free from twisting, warping and distortion.
7. Ensure to provide enough space (with cushion) between case and LCD panel to prevent external force adding on it, or it may cause damage to the LCD or degrade the display result.
8. Only hold the LCD module by its side. Never hold LCD module by add force on the heat seal or TAB.
9. Never add force to component of the LCD module. It may cause invisible damage or degrade of the reliability.
10. LCD module could be easily damaged by static electricity. Be careful to maintain an optimum anti-static work environment to protect the LCD module.
11. When peeling off the protective film from LCD, static charge may cause abnormal display pattern. It is normal and will resume to normal in a short while.
12. Take care and prevent get hurt by the LCD panel sharp edge.
13. Never operate the LCD module exceed the absolute maximum ratings.
14. Keep the signal line as short as possible to prevent noisy signal applying to LCD module.
15. Never apply signal to the LCD module without power supply.
16. IC chip (eg. TAB or COG) is sensitive to the light. Strong lighting environment could possibly cause malfunction. Light sealing structure casing is recommend.
17. LCD module reliability may be reduced by temperature shock.
18. When storing the LCD module, avoid exposure to the direct sunlight, high humidity, high temperature or low temperature. They may damage or degrade the LCD module