



深圳市拓普微科技开发有限公司

SHENZHEN TOPWAY TECHNOLOGY CO., LTD.

# LM32019ECW-1

## LCD Module User Manual

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

| Rev. | Descriptions              | Release Date |
|------|---------------------------|--------------|
| 0.1  | Preliminary release       | 2016-04-25   |
| 0.2  | Update Terminal Functions | 2018-05-05   |
|      |                           |              |
|      |                           |              |

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## 1. Basic Specifications

### 1.1 Display Specifications

- 1) LCD Display Mode : FSTN, Positive, Transmissive
- 2) Display Color : Display Data = "1" : Dark Gray (\*1)  
: Display Data = "0" : Light Gray (\*2)
- 3) Viewing Angle : 12 H
- 4) Driving Method : 1/240 duty, 1/16 bias
- 5) Backlight : White LED backlight

Note:

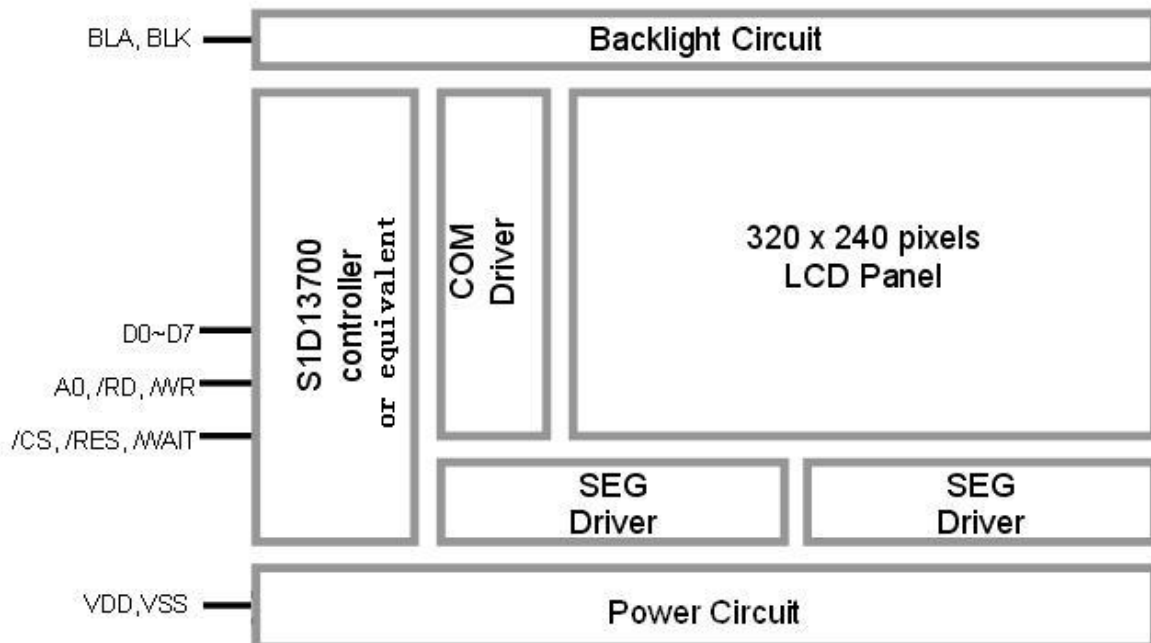
\*1. Color tone may slightly change by Temperature and Driving Condition.

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

### 1.2 Mechanical Specifications

- 1) Outline Dimension : 159.0 x 107.8 x 11.0 MAX.  
see attached Outline Drawing for details

### 1.3 Block Diagram



## 1.4 Terminal Functions

| Pin No. | Pin Name | I/O    | Descriptions  |
|---------|----------|--------|---|
| 1       | VSS      | Power  | 0V Power Supply, GND  |
| 2       | VDD      | Power  | Positive Power Supply   |
| 3       | NC       | -      | No Connection, leave open   |
| 4       | /WR      | Input  | Write enable input, active LOW  |
| 5       | /RD      | Input  | Read enable input, active LOW   |
| 6       | /CS      | Input  | Chip Select Signal<br>/CS=LOW: Data IO is enabled   |
| 7       | A0       | Input  | Data Type Select<br>A0=H: command write, display data or cursor add read<br>A0=L: status flag read, display data or parameter write |
| 8       | /RES     | Input  | Reset Signal:<br>/RES = L, Reset the LCD Module<br>/RES = H, Normal Running   |
| 9       | D0       | I/O    | 8-bit bi-directional data bus   |
| :       | :        |        |   |
| 16      | D7       |        |   |
| 17      | /WAIT    | Output | Wait signal (*1)  |
| 18      | NC       | -      | No Connection, leave open   |
| 19      | BLA      | Power  | Positive Power Supply for LED backlight   |
| 20      | BLK      | Power  | Negative Power Supply for LED backlight   |

note:

- \*1. If there is no read write activity, /WAIT will be in HZ state.

## 2. Absolute Maximum Ratings

| Items                 | Symbol   | Min.         | Max.         | Unit | Condition       |
|-----------------------|----------|--------------|--------------|------|-----------------|
| Supply Voltage        | $V_{DD}$ | 0            | +7.0         | V    | $V_{SS} = 0V$   |
| Input Voltage         | $V_{IN}$ | $V_{SS}-0.3$ | $V_{DD}+0.3$ | V    | $V_{SS} = 0V$   |
| Operating Temperature | $T_{OP}$ | -20          | +70          | °C   | No Condensation |
| Storage Temperature   | $T_{ST}$ | -30          | +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

$V_{SS}=0V, V_{DD}=3.3V, T_{OP}=25^{\circ}C$

| Items              | Symbol   | MIN.                | TYP. | MAX.                 | Unit | Applicable Pin                 |
|--------------------|----------|---------------------|------|----------------------|------|--------------------------------|
| Operating Voltage  | $V_{DD}$ | 3.0                 | 3.3  | 3.6                  | V    | VDD                            |
| Input High Voltage | $V_{IN}$ | $0.8 \times V_{DD}$ | -    | VDD                  | V    | D0-D7, /WR, /RD, /CS, A0, /RES |
| Input Low Voltage  | $V_{IN}$ | VSS                 | -    | $0.15 \times V_{DD}$ | V    | D0-D7, /WR, /RD, /CS, A0, /RES |
| Operating Current  | $I_{DD}$ | -                   | 37.0 | 92.5                 | mA   | VDD                            |

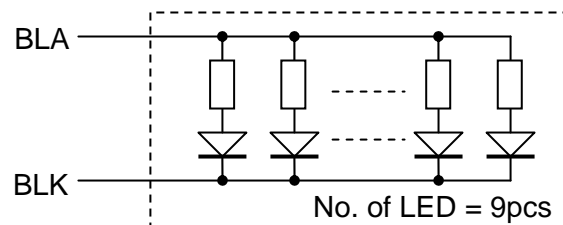
### 3.2 LED Backlight Circuit Characteristics

$BLK=0V, BLA=3.3V, T_{OP}=25^{\circ}C$

| Items           | Symbol    | MIN. | TYP. | MAX. | Unit | Applicable Pin |
|-----------------|-----------|------|------|------|------|----------------|
| Forward Voltage | BLA       | -    | 3.3  | -    | V    | BLA            |
| Forward Current | $I_{BLA}$ | -    | 153  | 180  | mA   | BLA            |

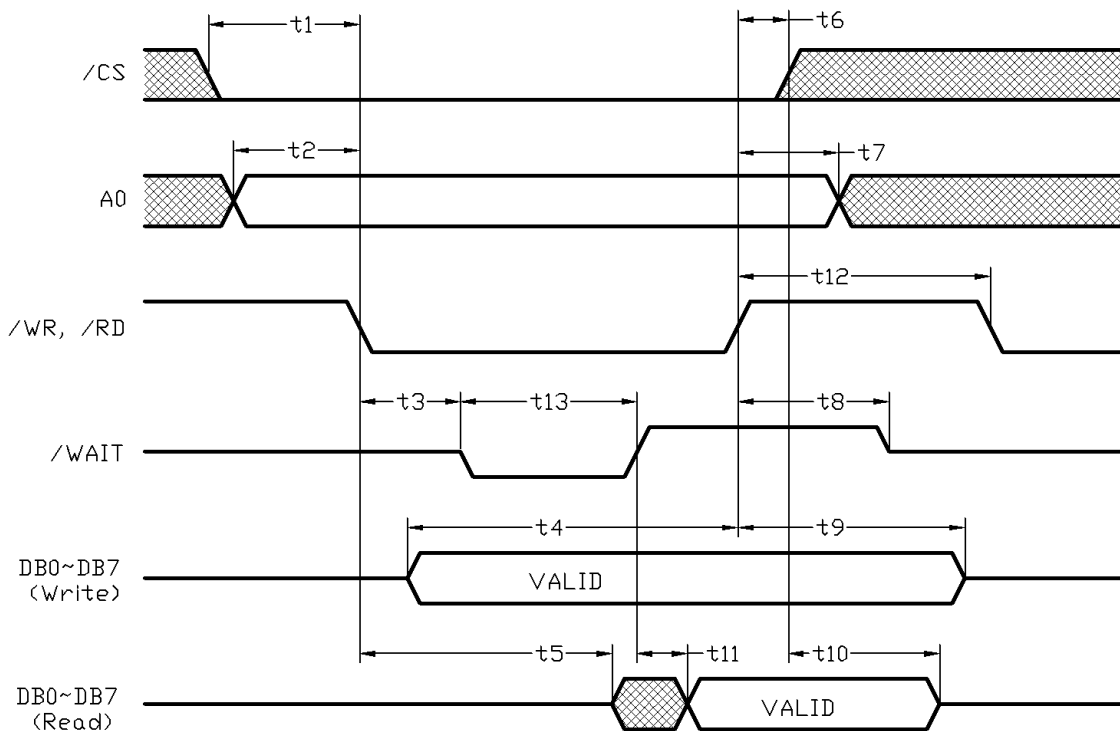
### Cautions:

Exceeding the recommended driving current could cause substantial damage to the backlight and shorten its lifetime.



### 3.3 AC Characteristics

#### 3.3.1 8080 Mode



$V_{SS}=0V, V_{DD}=3.3V, T_{OP}=25^{\circ}C$

| Item  | Symbol | MIN. | TYP. | MAX. | Unit |
|---|--------|------|------|------|------|
| /CS setup time                                      | t1     | 7    | -    | -    | ns   |
| A0 setup time                                       | t2     | 7    | -    | -    | ns   |
| /WR, /RD falling edge to /WAIT driven low           | t3     | 2.6  | -    | 11   | ns   |
| D[7:0] setup time to /WR rising edge (write cycle)  | t4     | (*2) | -    | -    | ns   |
| /RD falling edge to D[7:0] driven (read cycle)      | t5     | 4    | -    | -    | ns   |
| /CS hold time                                       | t6     | 9    | -    | -    | ns   |
| A0 hold time  | t7     | 9    | -    | -    | ns   |
| /RD, /WR rising edge to WAIT# high impedance        | t8     | 2.6  | -    | 7    | ns   |
| D[7:0] hold time from /WR rising edge (write cycle) | t9     | 6.5  | -    | -    | ns   |
| D[7:0] hold time from /CS rising edge (read cycle)  | t10    | 2.4  | -    | 18   | ns   |
| /WAIT rising edge to valid Data                     | t11    | -    | -    | (*3) | ns   |
| /RD, /WR pulse inactive time                        | t12    | (*4) | -    | -    | ns   |
| /WAIT pulse active time                             | t13    | -    | -    | (*5) | ns   |

Note:

\*1.  $T_s$  = System clock period

\*2.  $t_{4min}$  =  $2T_s + 5$

\*3.  $t_{11max}$  =  $1T_s + 5$  (for 3.3V)

\*4.  $t_{12min}$  =  $1T_s$  (for a read cycle followed by a read or write cycle)

=  $2T_s + 2$  (for a write cycle followed by a write cycle)

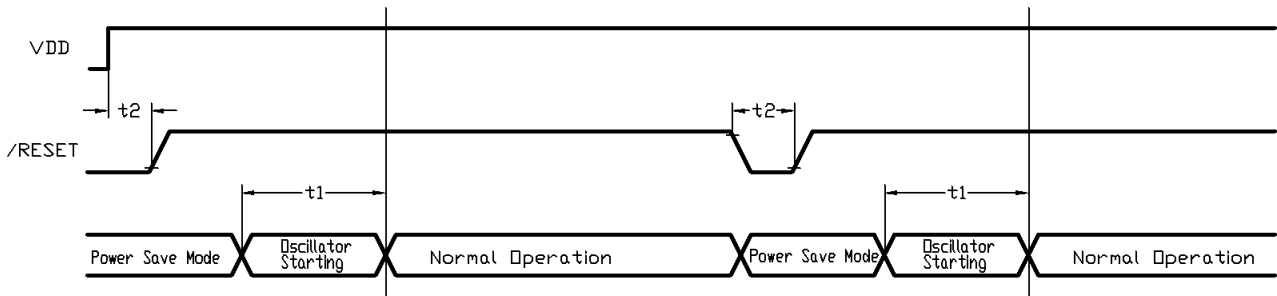
=  $5T_s + 2$  (for a write cycle followed by a read cycle)

\*5.  $t_{13max}$  =  $4T_s + 2$

\*6. Input signal rise/fall time should be less than 4.5ns

\*7. for details, please see the S1D13700 data sheet

### 3.4 Reset Timing



$V_{SS}=0V, V_{DD}=3.3V, T_{OP}=25^{\circ}C$

| Item                         | Symbol | MIN. | TYP. | MAX. | Unit |
|------------------------------|--------|------|------|------|------|
| Oscillator Stable Delay (*1) | t1     | 4.0  | -    | -    | ms   |
| Reset Pulse Duration (*2)    | t2     | 1.3  | -    | -    | ms   |

note:

- \*1. A delay is required after exiting power save mode. Writing the SYSTEM SET command will exit power save mode and start the internal oscillator.
- \*2. It requires a reset pulse after power-on in order to re-initialize its internal state.

## 4. Function Specifications

### 4.1 Resetting the LCD module

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

### 4.2 Display Pixel Map

|               |               |               |               |               |     |     |                 |                 |                 |                 |                 |
|---------------|---------------|---------------|---------------|---------------|-----|-----|-----------------|-----------------|-----------------|-----------------|-----------------|
| 1,1<br>(D7)   | 2,1<br>(D6)   | 3,1<br>(D5)   | 4,1<br>(D4)   | 5,1<br>(D3)   | --- | --- | 316,1<br>(D4)   | 317,1<br>(D3)   | 318,1<br>(D2)   | 319,1<br>(D1)   | 320,1<br>(D0)   |
| 1,2<br>(D7)   | 2,2<br>(D6)   | 3,2<br>(D5)   | 4,2<br>(D4)   | 5,2<br>(D3)   | --- | --- | 316,2<br>(D4)   | 317,2<br>(D3)   | 318,2<br>(D2)   | 319,2<br>(D1)   | 320,2<br>(D0)   |
| 1,3<br>(D7)   | 2,3<br>(D6)   | 3,3<br>(D5)   | 4,3<br>(D4)   | 5,3<br>(D3)   | --- | --- | 316,3<br>(D4)   | 317,3<br>(D3)   | 318,3<br>(D2)   | 319,3<br>(D1)   | 320,3<br>(D0)   |
| :             | :             | :             | :             | :             | :   | :   | :               | :               | :               | :               | :               |
| :             | :             | :             | :             | :             | :   | :   | :               | :               | :               | :               | :               |
| :             | :             | :             | :             | :             | :   | :   | :               | :               | :               | :               | :               |
| 1,238<br>(D7) | 2,238<br>(D6) | 3,238<br>(D5) | 4,238<br>(D4) | 5,238<br>(D3) | --- | --- | 316,238<br>(D4) | 317,238<br>(D3) | 318,238<br>(D2) | 319,238<br>(D1) | 320,238<br>(D0) |
| 1,239<br>(D7) | 2,239<br>(D6) | 3,239<br>(D5) | 4,239<br>(D4) | 5,239<br>(D3) | --- | --- | 316,239<br>(D4) | 317,239<br>(D3) | 318,239<br>(D2) | 319,239<br>(D1) | 320,239<br>(D0) |
| 1,240<br>(D7) | 2,240<br>(D6) | 3,240<br>(D5) | 4,240<br>(D4) | 5,240<br>(D3) | --- | --- | 316,240<br>(D4) | 317,240<br>(D3) | 318,240<br>(D2) | 319,240<br>(D1) | 320,240<br>(D0) |

Pixel mapping (Top View)

**Note:**

- \*1. Based on the top view of the LCD module,  
the 1, 1 (x, y) pixel is the upper-left pixel;  
the 320, 240 (x, y) pixel is the lower-right pixel.
- \*2. For the details of memory mapping please refer to S1D13700 datasheet.



4.3 Command Summary

| Command     | Parameter | A0 | /RD | /WR | D7  | D6  | D5  | D4  | D3   | D2  | D1   | D0   | HEX   | Descriptions   |
|-------------|-----------|----|-----|-----|-----|-----|-----|-----|------|-----|------|------|---|--|
| SYSTEM SET  | -         | 1  | 1   | 0   | 0   | 1   | 0   | 0   | 0    | 0   | 0    | 0    | 40  | Init device and display (with 8 parameters)  |
|             | P1        | 0  | 1   | 0   | 0   | 0   | IV  | 1   | W/S  | M2  | 0    | M0   | **  | M0=0: internal CG ROM<br>M0=1: internal CG RAM<br>M2=0: 8-pixel char height<br>M2=1: 16-pixel char height<br>W/S=0: single panel drive<br>W/S=1: dual panel drive<br>IV=0: Screen top-line correction<br>IV=1: No screen top-line correction |
|             | P2        | 0  | 1   | 0   | MOD | 0   | 0   | 0   |      |     | FX   |      | **  | FX=Horizontal Char Size in pixels – 1 (define the horizontal char size)<br>MOD=0: 16-line AC drive<br>MOD=1: two frame AC drive  |
|             | P3        | 0  | 1   | 0   | 0   | 0   | 0   | 0   |      |     | FY   |      | **  | FY=Vertical Char Size in pixels – 1 (define the vertical char size)  |
|             | P4        | 0  | 1   | 0   |     |     |     |     | C/R  |     |      |      | **  | C/R: Character Bytes per Row   |
|             | P5        | 0  | 1   | 0   |     |     |     |     | TC/R |     |      |      | **  | TC/R: Total Char Bytes per Row (including horizontal blanking)   |
|             | P6        | 0  | 1   | 0   |     |     |     |     | L/F  |     |      |      | **  | L/F: Lines per Frame   |
|             | P7        | 0  | 1   | 0   |     |     |     |     | APL  |     |      |      | **  | APL: Horizontal address range of the virtual screen (low byte)   |
|             | P8        | 0  | 1   | 0   |     |     |     |     | APH  |     |      |      | **  | APH: Horizontal address range of the virtual screen (high byte)  |
| POWER SAVE  | -         | 1  | 1   | 0   | 0   | 1   | 0   | 1   | 0    | 0   | 1    | 1    | 53  | Power Save Mode Enable   |
| DISP ON/OFF | -         | 1  | 1   | 0   | 0   | 1   | 0   | 1   | 1    | 0   | 0    | D    | 58 / 59   | Enable and disable display and display flashing (with 1 parameter)<br>D=0: Display OFF<br>D=1: Display ON  |
|             | P1        | 0  | 1   | 0   | FP5 | FP4 | FP3 | FP2 | FP1  | FP0 | FC1  | FC0  | **  | Each pair of bit in FP sets the attributes of one screen block   |
| SCROLL      | -         | 1  | 1   | 0   | 0   | 1   | 0   | 0   | 0    | 1   | 0    | 0    | 44  | Set display start address and display regions (with 8 or 10 parameters)  |
|             | P1        | 0  | 1   | 0   | A7  | A6  | A5  | A4  | A3   | A2  | A1   | A0   | **  | Screen Block 1 Start Address (SAD1) LSB  |
|             | P2        | 0  | 1   | 0   | A15 | A14 | A13 | A12 | A11  | A10 | A9   | A8   | **  | Screen Block 1 Start Address (SAD1) MSB  |
|             | P3        | 0  | 1   | 0   | L7  | L6  | L5  | L4  | L3   | L2  | L1   | L0   | **  | Screen Block 1 Size Register (SL1)   |
|             | P4        | 0  | 1   | 0   | A7  | A6  | A5  | A4  | A3   | A2  | A1   | A0   | **  | Screen Block 2 Start Address (SAD2) LSB  |
|             | P5        | 0  | 1   | 0   | A15 | A14 | A13 | A12 | A11  | A10 | A9   | A8   | **  | Screen Block 2 Start Address (SAD2) MSB  |
|             | P6        | 0  | 1   | 0   | L7  | L6  | L5  | L4  | L3   | L2  | L1   | L0   | **  | Screen Block 2 Size Register (SL2)   |
|             | P7        | 0  | 1   | 0   | A7  | A6  | A5  | A4  | A3   | A2  | A1   | A0   | **  | Screen Block 3 Start Address (SAD3) LSB  |
|             | P8        | 0  | 1   | 0   | A15 | A14 | A13 | A12 | A11  | A10 | A9   | A8   | **  | Screen Block 3 Start Address (SAD3) MSB  |
|             | P9        | 0  | 1   | 0   | A7  | A6  | A5  | A4  | A3   | A2  | A1   | A0   | **  | Screen Block 4 Start Address (SAD4) LSB<br>(for dual panel drive and two layer config are select)  |
| P10         | 0         | 1  | 0   | A15 | A14 | A13 | A12 | A11 | A10  | A9  | A8   | **   | Screen Block 4 Start Address (SAD4) MSB<br>(for dual panel drive and two layer config are select) |  |
| CSRFORM     | -         | 1  | 1   | 0   | 0   | 1   | 0   | 1   | 1    | 1   | 0    | 1    | 5D  | Set cursor type (with 2 parameters)  |
|             | P1        | 0  | 1   | 0   | 0   | 0   | 0   | 0   | X3   | X2  | X1   | X0   | **  | CRX  |
|             | P2        | 0  | 1   | 0   | CM  | 0   | 0   | 0   | Y3   | Y2  | Y1   | Y0   | **  | CRY<br>CM=0: underscore cursor; CM=1: block cursor   |
| CSRDIR      | -         | 1  | 1   | 0   | 0   | 1   | 0   | 0   | 1    | 1   | CD1  | CD0  | 4C~4F   | Set Direction of Cursor movement<br>CD=00: Right; CD=01: Left; CD=10: Up; CD=11: Down  |
| OVLAY       | -         | 1  | 1   | 0   | 0   | 1   | 0   | 1   | 1    | 0   | 1    | 1    | 5B  | Set display overlay format (with 1 parameters)   |
|             | P1        | 0  | 1   | 0   | 0   | 0   | 0   | OV  | DM2  | DM1 | MX1  | MX0  | **  |  |
| CGRAM ADR   | -         | 1  | 1   | 0   | 0   | 1   | 0   | 1   | 1    | 1   | 0    | 0    | 5C  | Set Start address of char generator RAM (with 2 parameters)  |
|             | P1        | 0  | 1   | 0   | A7  | A6  | A5  | A4  | A3   | A2  | A1   | A0   | **  | SAGL   |
|             | P2        | 0  | 1   | 0   | A15 | A14 | A13 | A12 | A11  | A10 | A9   | A8   | **  | SAGH   |
| HDOT SCR    | -         | 1  | 1   | 0   | 0   | 1   | 0   | 1   | 1    | 0   | 1    | 0    | 5A  | Set horizontal scroll position (with 1 parameters)   |
|             | P1        | 0  | 1   | 0   | 0   | 0   | 0   | 0   | 0    | D2  | D1   | D0   | **  |  |
| CSRW        | -         | 1  | 1   | 0   | 0   | 1   | 0   | 0   | 0    | 1   | 1    | 0    | 46  | Set cursor address (with 2 parameters)   |
|             | P1        | 0  | 1   | 0   | A7  | A6  | A5  | A4  | A3   | A2  | A1   | A0   | **  | CSRL   |
|             | P2        | 0  | 1   | 0   | A15 | A14 | A13 | A12 | A11  | A10 | A9   | A8   | **  | CSRH   |
| CSRR        | -         | 1  | 1   | 0   | 0   | 1   | 0   | 0   | 0    | 1   | 1    | 1    | 47  | Read Cursor Address (with 2 parameters)  |
|             | P1        | 1  | 0   | 1   | A7  | A6  | A5  | A4  | A3   | A2  | A1   | A0   | **  | CSRL   |
|             | P2        | 1  | 0   | 1   | A15 | A14 | A13 | A12 | A11  | A10 | A9   | A8   | **  | CSRH   |
| GRAY SCALE  | -         | 1  | 1   | 0   | 0   | 1   | 1   | 0   | 0    | 0   | 0    | 0    | 60  | select the gray scale depth (in bits-per-pixel)  |
|             | P1        | 0  | 1   | 0   | 0   | 0   | 0   | 0   | 0    | 0   | BPP1 | BPP2 | **  | BPP=00: 1 bits-per-pixel; BPP=01: 2 bits-per-pixel;<br>BPP=10: 4 bits-per-pixel; BPP=01: reserved  |
| MWRITE      | -         | 1  | 1   | 0   | 0   | 1   | 0   | 0   | 0    | 0   | 1    | 0    | 42  | Write to display memory (with n parameters)  |
|             | P1        | 0  | 1   | 0   |     |     |     |     |      |     |      |      | **  | Memory Data<br>Display memory data   |
|             | :         | :  | :   | :   |     |     |     |     |      |     |      |      | **  |  |
|             | Pn        | 0  | 1   | 0   |     |     |     |     |      |     |      |      | **  | Memory Data  |
| MREAD       | -         | 1  | 1   | 0   | 0   | 1   | 0   | 0   | 0    | 0   | 1    | 1    | 43  | Read from display memory (with n parameters)   |
|             | P1        | 1  | 0   | 1   |     |     |     |     |      |     |      |      | **  | Memory Data<br>Display memory data   |
|             | :         | :  | :   | :   |     |     |     |     |      |     |      |      | **  |  |
|             | Pn        | 1  | 0   | 1   |     |     |     |     |      |     |      |      | **  | Memory Data  |

Note:  
For details please refer to S1D13700 datasheet.

#### 4.4 Initialization Setting Example

The following setting should be issue to LCD module after hardware reset.  
(example could be adjusted if necessary.)

| Command     | Parameter | A0 | /RD | /WR | Value (binary) | HEX | Descriptions   |
|-------------|-----------|----|-----|-----|----------------|-----|--|
| SYSTEM SET  | -         | 1  | 1   | 0   | 0100 0000      | 40  | Init device and display (with 8 parameters)  |
|             | P1        | 0  | 1   | 0   | 0011 0000      | 30  | M0=0: internal CG ROM<br>M2=0: 8-pixel char height<br>W/S=0: single panel drive<br>IV=1: No screen top-line correction |
|             | P2        | 0  | 1   | 0   | 1000 0111      | 87  | FX=7: the horizontal char size=7+1=8<br>WF=1: two frame AC drive   |
|             | P3        | 0  | 1   | 0   | 0000 0111      | 07  | FY=7: the vertical char size=7+1=8   |
|             | P4        | 0  | 1   | 0   | 0010 1000      | 28  | C/R: Character Bytes per Row   |
|             | P5        | 0  | 1   | 0   | 0100 1001      | 47  | TC/R: Total Char Bytes per Row (including horizontal blanking)   |
|             | P6        | 0  | 1   | 0   | 1110 1111      | EF  | L/F: Lines per Frame   |
|             | P7        | 0  | 1   | 0   | 0010 1000      | 28  | APL: Horizontal address range of the virtual screen (low byte)   |
|             | P8        | 0  | 1   | 0   | 0000 0000      | 00  | APH: Horizontal address range of the virtual screen (high byte)  |
| DISP ON/OFF | -         | 1  | 1   | 0   | 0101 1001      | 59  | Display ON   |
|             | P1        | 0  | 1   | 0   | 0000 0100      | 04  | sets the attributes of screen block (SAD1 on, cursor off)  |
| SCROLL      | -         | 1  | 1   | 0   | 0100 0100      | 44  | Set cursor type (with 10 parameters)   |
|             | P1        | 0  | 1   | 0   | 0000 0000      | 00  | SAD 1L   |
|             | P2        | 0  | 1   | 0   | 0000 0000      | 00  | SAD 1H   |
|             | P3        | 0  | 1   | 0   | 1110 1111      | EF  | SL1  |
|             | P4        | 0  | 1   | 0   | 0000 0000      | 00  | SAD 2L (not assigned in this example)  |
|             | P5        | 0  | 1   | 0   | 0000 0000      | 00  | SAD 2H (not assigned in this example)  |
|             | P6        | 0  | 1   | 0   | 1110 1111      | EF  | SL2  |
|             | P7        | 0  | 1   | 0   | 0000 0000      | 00  | SAD3L (not assigned in this example)   |
|             | P8        | 0  | 1   | 0   | 0000 0000      | 00  | SAD3H (not assigned in this example)   |
| CSRFORM     | -         | 1  | 1   | 0   | 0101 1101      | 5D  | Set cursor type (with 2 parameters)  |
|             | P1        | 0  | 1   | 0   | 0000 0111      | 07  | CRX  |
|             | P2        | 0  | 1   | 0   | 0001 0111      | 17  | CRY  |
| CSRDIR      | -         | 1  | 1   | 0   | 0100 1100      | 4C  | Set Direction of Cursor movement   |
| OVLAY       | -         | 1  | 1   | 0   | 0101 1011      | 5B  | Set display overlay format (with 1 parameters)   |
|             | P1        | 0  | 1   | 0   | 0000 0101      | 05  | OV=0: two layer in used; DM1=0: layer 3 as text mode;<br>DM0=1: layer 1 as graphic mode; MX=01: layer1 XOR Layer 2     |
| HDOT SCR    | -         | 1  | 1   | 0   | 0101 1010      | 5A  | Set horizontal scroll position (with 1 parameters)   |
|             | P1        | 0  | 1   | 0   | 0000 0000      | 00  | no scroll  |
| GRAY SCALE  | -         | 1  | 1   | 0   | 0110 0000      | 60  | sel select the gray scale depth (in bits-per-pixel)  |
|             | P1        | 0  | 1   | 0   | 0000 0000      | 00  | BPP=00: 1 bits-per-pixel   |
| CSRW        | -         | 1  | 1   | 0   | 0100 0110      | 46  | Set cursor address (with 2 parameters)   |
|             | P1        | 0  | 1   | 0   | 0000 0000      | 00  | CSRL   |
|             | P2        | 0  | 1   | 0   | 0000 0000      | 00  | CSRH   |
| MWRITE      | -         | 1  | 1   | 0   | 0100 0010      | 42  | Write to display memory (with n parameters)  |
|             | P1        | 0  | 1   | 0   | Memory Data    | **  | Display memory data  |
|             | :         | :  | :   | :   | :              | **  |  |
|             | Pn        | 0  | 1   | 0   | Memory Data    | **  |  |

Note:

For details please refer to S1D13700 datasheet.

## 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