

# NHD-C12864MZ-NSW-BTW

## COG (Chip-On-Glass) Liquid Crystal Display Module

|         |                           |
|---------|---------------------------|
| NHD-    | Newhaven Display          |
| C12864- | 128 x 64 pixels           |
| MZ-     | Model                     |
| N-      | Transmissive              |
| SW-     | Side White LED backlight  |
| B-      | STN- Blue (-)             |
| T-      | 12:00 view                |
| W-      | Wide Temp (-20°C ~ +70°C) |
|         | <b>RoHS Compliant</b>     |

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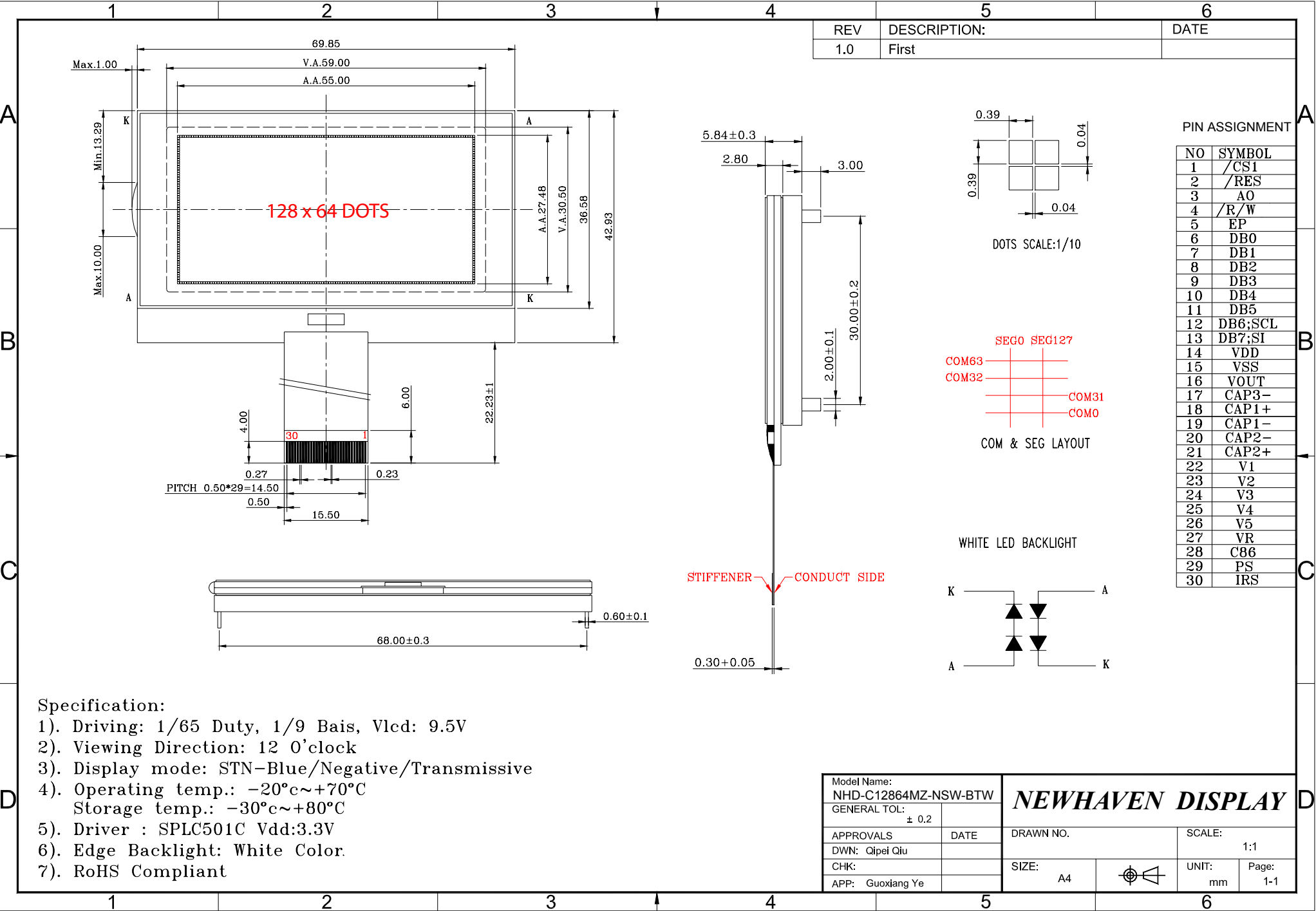
## Document Revision History

| Revision | Date       | Description                                           | Changed by |
|----------|------------|-------------------------------------------------------|------------|
| 0        | 9/1/2008   | Initial Release                                       | -          |
| 1        | 9/28/2009  | User guide reformat                                   | BE         |
| 2        | 10/13/2009 | Updated Pin Description and Electrical Characteristic | MC         |
| 3        | 11/20/2009 | Updated backlight supply current                      | MC         |

## Functions and Features

- 128 x 64 pixels
- Built-in SPLC501C controller
- +3.3V power supply
- 1/65 duty cycle; 1/9 bias
- RoHS Compliant

Mechanical Drawing

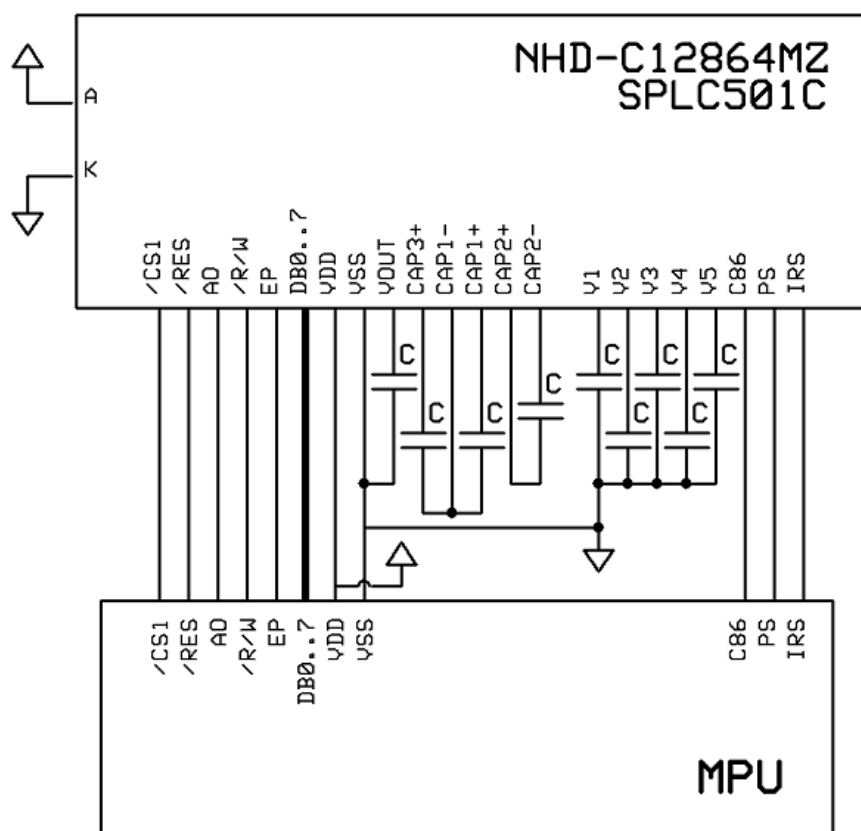


## Pin Description and Wiring Diagram

| Pin No. | Symbol | External Connection | Function Description                                                                                                                                                                  |
|---------|--------|---------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 1       | /CS1   | MPU                 | Active LOW chip select                                                                                                                                                                |
| 2       | /RES   | MPU                 | Active LOW Reset signal                                                                                                                                                               |
| 3       | A0     | MPU                 | Register select signal. 0: instruction; 1: data                                                                                                                                       |
| 4       | R/W    | MPU                 | Read/write select signal. R/W=1: Read R/W=0: Write                                                                                                                                    |
| 5       | EP     | MPU                 | Operation enable signal. Falling edge triggered.                                                                                                                                      |
| 6       | DB0    | MPU                 | Parallel Interface<br>DB0-DB7: Bi-directional 8-bit data bus<br><br>Serial Interface:<br>DB0-DB5: No connect in serial mode<br>DB6= Serial clock (SCL)<br>DB7= Serial data input (SI) |
| 7       | DB1    | MPU                 |                                                                                                                                                                                       |
| 8       | DB2    | MPU                 |                                                                                                                                                                                       |
| 9       | DB3    | MPU                 |                                                                                                                                                                                       |
| 10      | DB4    | MPU                 |                                                                                                                                                                                       |
| 11      | DB5    | MPU                 |                                                                                                                                                                                       |
| 12      | DB6    | MPU                 |                                                                                                                                                                                       |
| 13      | DB7    | MPU                 |                                                                                                                                                                                       |
| 14      | VDD    | Power Supply        | Power supply for LCD and logic (+3.3V)                                                                                                                                                |
| 15      | VSS    | Power Supply        | Ground                                                                                                                                                                                |
| 16      | VOUT   | Power Supply        | Connect to 1uF cap to VSS                                                                                                                                                             |
| 17      | CAP3-  | Power Supply        | Connect to 1uF cap to CAP1+ (PIN-18)                                                                                                                                                  |
| 18      | CAP1+  | Power Supply        | Connect to 1uF cap to CAP3-(PIN17) and CAP1-(PIN19)                                                                                                                                   |
| 19      | CAP1-  | Power Supply        | Connect to 1uF cap to CAP1+ (PIN-18)                                                                                                                                                  |
| 20      | CAP2-  | Power Supply        | Connect to 1uF cap to CAP2+ (PIN-21)                                                                                                                                                  |
| 21      | CAP2+  | Power Supply        | Connect to 1uF cap to CAP2- (PIN-20)                                                                                                                                                  |
| 22      | V1     | Power Supply        | 1.0uF-2.2uF cap to VSS                                                                                                                                                                |
| 23      | V2     | Power Supply        | 1.0uF-2.2uF cap to VSS                                                                                                                                                                |
| 24      | V3     | Power Supply        | 1.0uF-2.2uF cap to VSS                                                                                                                                                                |
| 25      | V4     | Power Supply        | 1.0uF-2.2uF cap to VSS                                                                                                                                                                |
| 26      | V5     | Power Supply        | 1.0uF-2.2uF cap to VSS                                                                                                                                                                |
| 27      | VR     | -                   | No Connect                                                                                                                                                                            |
| 28      | C86    | MPU                 | Select MPU interface pin. C86=H: 6800; C86=L: 8080                                                                                                                                    |
| 29      | PS     | MPU                 | Parallel/Serial select. PS= H: Parallel; PS=L: Serial                                                                                                                                 |
| 30      | IRS    | MPU                 | Internal resistor select (high to use internal resistors)                                                                                                                             |
|         |        |                     |                                                                                                                                                                                       |
| A       |        | Power Supply        | Power supply for LED Backlight (+6.0V)                                                                                                                                                |
| K       |        | Power Supply        | Ground for Backlight                                                                                                                                                                  |

**Recommended LCD connector:** 0.5mm Pitch, 30 pin FFC. Molex p/n: 52892-3095

**Backlight connector:** -- **Mates with:** --



## Electrical Characteristics

| Item                        | Symbol | Condition         | Min. | Typ. | Max. | Unit |
|-----------------------------|--------|-------------------|------|------|------|------|
| Operating Temperature Range | TOP    | Absolute Max      | -20  | -    | +70  | °C   |
| Storage Temperature Range   | TST    | Absolute Max      | -30  | -    | +80  | °C   |
| Supply Voltage              | VDD    |                   | 3.0  | 3.3  | 3.5  | V    |
| Supply Current              | IDD    | Ta=25°C, VDD=3.3V | -    | 1.5  | 2.5  | mA   |
| Supply for LCD (contrast)   | VDD-V0 | Ta=25°C           | -    | 9.5  | -    | V    |
| "H" Level input             | Vih    |                   | 2.2  | -    | VDD  | V    |
| "L" Level input             | Vil    |                   | 0    | -    | 0.6  | V    |
| "H" Level output            | Voh    |                   | 2.4  | -    | -    | V    |
| "L" Level output            | Vol    |                   | -    | -    | 0.4  | V    |
| LED Backlight voltage       | VLED   |                   | -    | 6.0  | -    | V    |
| LED Backlight current       | ILED   | VLED=6.0V         | -    | 30   | 45   | mA   |

## Optical Characteristics

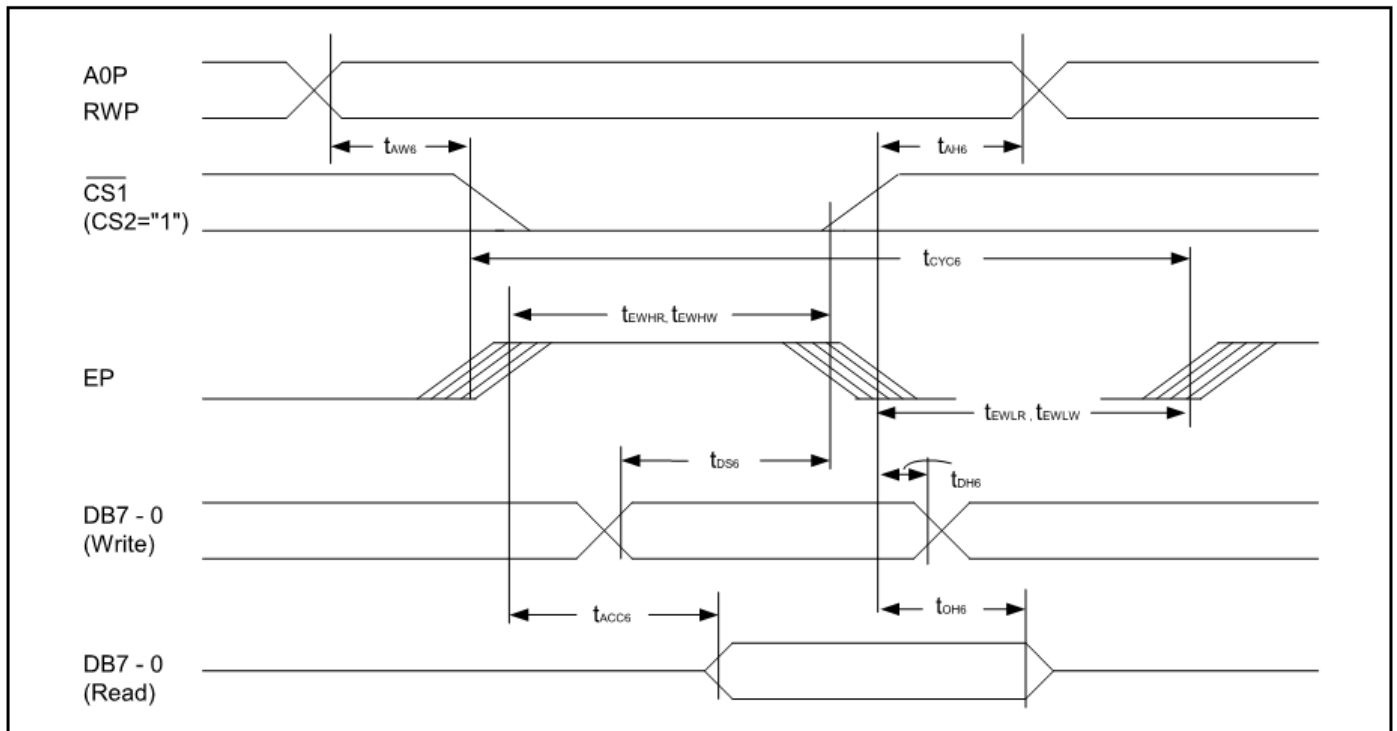
| Item                       | Symbol   | Condition   | Min. | Typ. | Max. | Unit |
|----------------------------|----------|-------------|------|------|------|------|
| Viewing Angle - Vertical   | $\theta$ | CR $\geq$ 2 | -25  | -    | -    | °    |
| Viewing Angle - Horizontal | $\Phi$   | CR $\geq$ 2 | -30  | -    | +30  | °    |
| Contrast Ratio             | CR       |             | -    | 2    | -    | -    |
| Response Time (rise)       | Tr       |             | -    | 120  | 150  | ms   |
| Response Time (fall)       | Tf       |             | -    | 120  | 150  | ms   |

## Controller Information

Built-in SPLC501C. Download specification at [http://www.newhavendisplay.com/app\\_notes/SPLC501C.pdf](http://www.newhavendisplay.com/app_notes/SPLC501C.pdf)

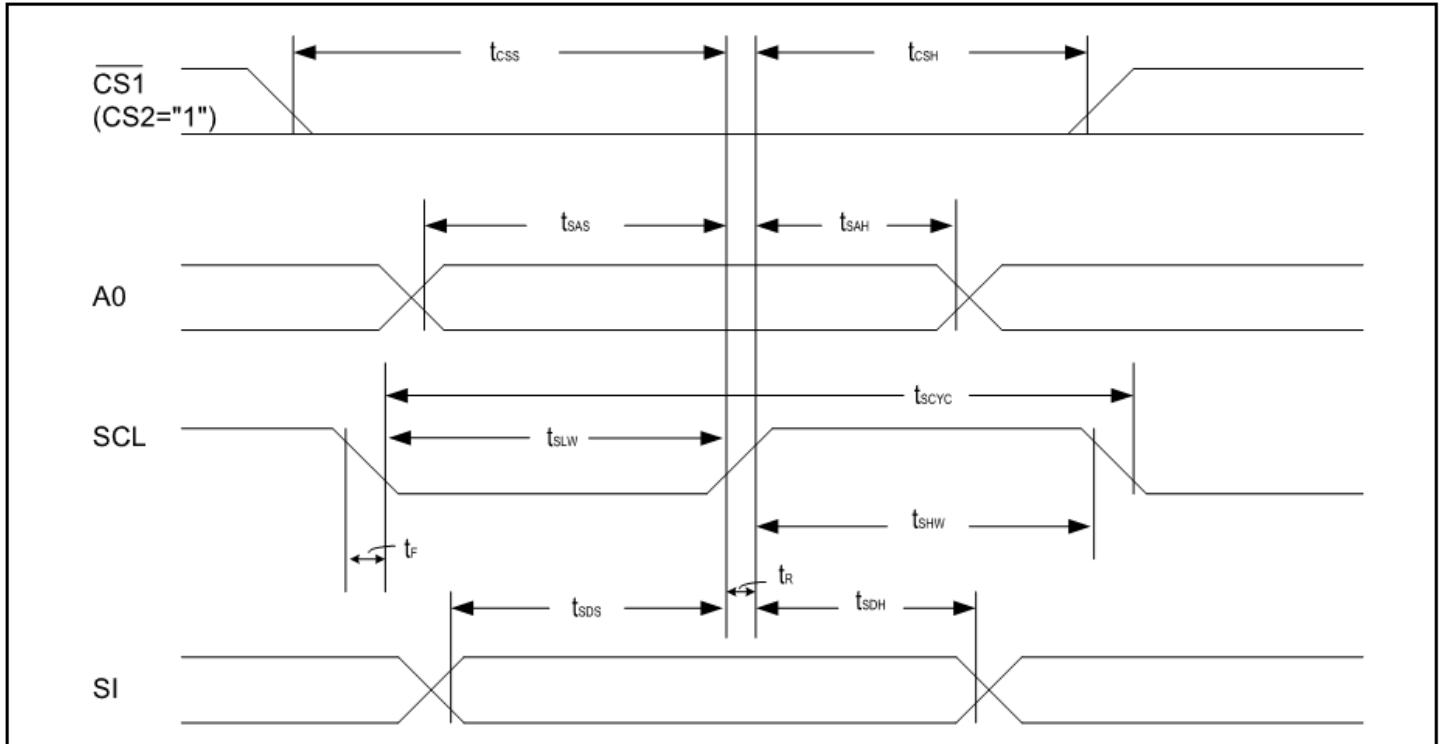
## Timing Characteristics

### 8.6.2. System bus read/write characteristics 2 (6800 series MPU)



| Item                |       | Signal  | Symbol     | Condition     | Rating |      | Units |
|---------------------|-------|---------|------------|---------------|--------|------|-------|
|                     |       |         |            |               | Min.   | Max. |       |
| Address hold time   |       | A0P     | $t_{AH6}$  |               | 0      | -    | ns    |
| Address setup time  |       |         | $t_{AW6}$  |               | 0      | -    | ns    |
| System cycle time   |       | A0P     | $t_{CYC6}$ |               | 166    | -    | ns    |
| Data setup time     |       | DB7 - 0 | $t_{DS6}$  | $C_L = 100pF$ | 30     | -    | ns    |
| Data hold time      |       |         | $t_{DH6}$  |               | 10     | -    | ns    |
| Access time         |       |         | $t_{ACC6}$ |               | -      | 70   | ns    |
| Output disable time |       |         | $t_{OH6}$  |               | 10     | 50   | ns    |
| Enable H pulse time | Read  | EP      | $t_{EWHR}$ |               | 70     | -    | ns    |
|                     | Write |         | $t_{EWHW}$ |               | 30     | -    | ns    |
| Enable L pulse time | Read  | EP      | $t_{EWLR}$ |               | 30     | -    | ns    |
|                     | Write |         | $t_{EWLW}$ |               | 30     | -    | ns    |

## The Serial Interface:



| Item                | Signal | Symbol            | Condition | Rating |      | Units |
|---------------------|--------|-------------------|-----------|--------|------|-------|
|                     |        |                   |           | Min.   | Max. |       |
| Serial Clock Period |        | $t_{\text{SCYC}}$ | -         | 200    | -    | ns    |
| SCL 'H' pulse width | SCL    | $t_{\text{SHW}}$  | -         | 75     | -    | ns    |
| SCL 'L' pulse width |        | $t_{\text{SLW}}$  | -         | 75     | -    | ns    |
| Address setup time  |        | $t_{\text{SAS}}$  | -         | 50     | -    | ns    |
| Address hold time   | A0P    | $t_{\text{SAH}}$  | -         | 100    | -    | ns    |
| Data setup time     |        | $t_{\text{SDS}}$  | -         | 50     | -    | ns    |
| Data hold time      | SI     | $t_{\text{SDH}}$  | -         | 50     | -    | ns    |
| CS-SCL time         | CS     | $t_{\text{CSS}}$  | -         | 100    | -    | ns    |
|                     |        | $t_{\text{CSH}}$  | -         | 100    | -    | ns    |

# Table of Commands

| Command                                                           | Command Code |    |    |            |     |                         |     |                                  |                |     |     | Function                                                                         |
|-------------------------------------------------------------------|--------------|----|----|------------|-----|-------------------------|-----|----------------------------------|----------------|-----|-----|----------------------------------------------------------------------------------|
|                                                                   | A0P          | RD | WR | DB7        | DB6 | DB5                     | DB4 | DB3                              | DB2            | DB1 | DB0 |                                                                                  |
| 1). Display ON/OFF                                                | 0            | 1  | 0  | 1          | 0   | 1                       | 0   | 1                                | 1              | 1   | 0   | LCD display ON/OFF<br>0: OFF, 1: ON                                              |
| 2). Display start line set                                        | 0            | 1  | 0  | 0          | 1   | Display start address   |     |                                  |                |     | 1   | Sets the display RAM display start line address                                  |
| 3). Page address set                                              | 0            | 1  | 0  | 1          | 0   | 1                       | 1   | Page address                     |                |     |     | Sets the display RAM page address                                                |
| 4). Column address set upper bit                                  | 0            | 1  | 0  | 0          | 0   | 0                       | 1   | Most significant column address  |                |     |     | Sets the most significant 4 bits of the display RAM column address.              |
| Column address set lower bit                                      | 0            | 1  | 0  | 0          | 0   | 0                       | 0   | Least significant column address |                |     |     | Set the least significant 4 bits of the display RAM column address.              |
| 5). Status read                                                   | 0            | 0  | 1  | Status     |     |                         |     | 0                                | 0              | 0   | 0   | Reads the status data                                                            |
| 6). Display data write                                            | 1            | 1  | 0  | Write data |     |                         |     |                                  |                |     |     | Writes to the display RAM                                                        |
| 7). Display data read                                             | 1            | 0  | 1  | Read data  |     |                         |     |                                  |                |     |     | Reads from the display RAM                                                       |
| 8). ADC select                                                    | 0            | 1  | 0  | 1          | 0   | 1                       | 0   | 0                                | 0              | 0   | 0   | Sets the display RAM address SEG output correspondence<br>0: normal, 1:reverse   |
| 9). Display normal/reverse                                        | 0            | 1  | 0  | 1          | 0   | 1                       | 0   | 0                                | 1              | 1   | 0   | Sets the LCD display normal/ reverse<br>0: normal, 1:reverse                     |
| 10). Display all points ON/OFF                                    | 0            | 1  | 0  | 1          | 0   | 1                       | 0   | 0                                | 1              | 0   | 0   | Display all points<br>0: normal display<br>1: all points ON                      |
| 11). LCD bias set                                                 | 0            | 1  | 0  | 1          | 0   | 1                       | 0   | 0                                | 0              | 1   | 0   | Sets the LCD driver voltage bias ratio<br>SPLC501C.....0:1/9, 1:1/7              |
| 12). Read/modify/write                                            | 0            | 1  | 0  | 1          | 1   | 1                       | 0   | 0                                | 0              | 0   | 0   | Column address increment<br>At write: +1<br>At read: 0                           |
| 13). End                                                          | 0            | 1  | 0  | 1          | 1   | 1                       | 0   | 1                                | 1              | 1   | 0   | Clear read/modify/write                                                          |
| 14). Reset                                                        | 0            | 1  | 0  | 1          | 1   | 1                       | 0   | 0                                | 0              | 1   | 0   | Internal reset                                                                   |
| 15). Common output mode select                                    | 0            | 1  | 0  | 1          | 1   | 0                       | 0   | 0                                | *              | *   | *   | Select COM output scan direction<br>0: normal direction,<br>1: reverse direction |
| 16). Power control set                                            | 0            | 1  | 0  | 0          | 0   | 1                       | 0   | 1                                | Operating mode |     |     | Select internal power supply operating mode                                      |
| 17). V <sub>s</sub> voltage regulator internal resistor ratio set | 0            | 1  | 0  | 0          | 0   | 1                       | 0   | 0                                | Resistor ratio |     |     | Select internal resistor ratio (Rb/Ra) mode                                      |
| 18). Electronic volume mode set                                   | 0            | 1  | 0  | 1          | 0   | 0                       | 0   | 0                                | 0              | 0   | 1   | Set the V <sub>s</sub> output voltage electronic volume register                 |
| Electronic volume register set                                    | 0            | 1  | 0  | *          | *   | Electronic volume value |     |                                  |                |     |     |                                                                                  |



| Command                                                             | Command Code |                        |                        |         |         |         |         |         |         |         |         | Function                                                                                 |
|---------------------------------------------------------------------|--------------|------------------------|------------------------|---------|---------|---------|---------|---------|---------|---------|---------|------------------------------------------------------------------------------------------|
|                                                                     | A0P          | $\overline{\text{RD}}$ | $\overline{\text{WR}}$ | DB7     | DB6     | DB5     | DB4     | DB3     | DB2     | DB1     | DB0     |                                                                                          |
| 19). Static indicator<br>ON/OFF<br>Static indicator<br>Register set |              |                        |                        | 1       | 0       | 1       | 0       | 1       | 1       | 0       | 0<br>1  | 0: OFF, 1: ON<br><br>Set the flashing mode                                               |
| 20). Page Blink<br>Page selection                                   | 0<br>0       | 1<br>1                 | 0<br>0                 | 1<br>P7 | 1<br>P6 | 0<br>P5 | 1<br>P4 | 0<br>P3 | 1<br>P2 | 0<br>P1 | 1<br>P0 | P7 - 0: 1 - blinking page<br>0 - no blinking, normal display                             |
| 21). Driving Mode Set<br>Mode selection                             | 0<br>0       | 1<br>1                 | 0<br>0                 | 1<br>D1 | 1<br>D0 | 0<br>0  | 1<br>0  | 0<br>0  | 0<br>0  | 1<br>0  | 0<br>0  | Set the driving mode register<br>Driving capability (D1, D0):<br>(1,1)>(0,0)>(0,1)>(1,0) |
| 22). Power saver                                                    |              |                        |                        |         |         |         |         |         |         |         |         | Display OFF and display all points ON<br>compound command                                |
| 23). NOP                                                            | 0            | 1                      | 0                      | 1       | 1       | 1       | 0       | 0       | 0       | 1       | 1       | Command for non-operation                                                                |
| 24). Test                                                           | 0            | 1                      | 0                      | 1       | 1       | 1       | 1       | *       | *       | *       | *       | Command for IC test. Do not use<br>this command                                          |
|                                                                     |              |                        |                        | 1       | 1       | 0       | 1       | 0       | 1       | 0       | 0       |                                                                                          |

## Example Initialization Program

```
'-----  
Sub Init  
Reset P3.7          'set Read/write to '0' for write  
Reset P3.0          'RS  
Set P3.1            'reset  
Reset P3.4 'E  
'Set P3.3  
'Reset P3.3  
Waitms 2  
'Set P3.3  
Waitms 20  
A = &HA2            '1/9 BIAS  
Call Writecom  
A = &HA0            'ADC SELECT , NORMAL  
Call Writecom  
A = &HC8            'COM OUTPUT REVERSE  
Call Writecom  
A = &HA4            'DISPLAY ALL POINTS NORMAL  
Call Writecom  
A = &H40            'DISPLAY START LINE SET  
Call Writecom  
A = &H25            'INTERNAL RESISTOR RATIO  
Call Writecom  
A = &H81            'ELECTRONIC VOLUME MODE SET  
Call Writecom  
A = &H10            'ELECTRONIC VOLUME  
Call Writecom  
A = &H2F            'POWER CONTROLLER SET  
Call Writecom  
A = &HAF            'DISPLAY ON  
Call Writecom  
End Sub
```

```
'-----  
Sub Writecom  
Reset P3.0          'A0 low  
Reset P3.7          'R/W low  
Set P3.6            'CS1  
Set P3.4            'E  
P1 = A  
Reset P3.4  
Reset P3.6  
Reset P3.7  
End Sub
```

```
Sub Writedata  
Set P3.0            'A0 high  
Reset P3.7          'R/W low  
Set P3.6            'CS1  
Set P3.4            'E  
P1 = A  
Reset P3.4  
Reset P3.6  
Reset P3.7  
End Sub
```

```
'-----
```

## Quality Information

| Test Item                             | Content of Test                                                                                                                 | Test Condition                                                                      | Note |
|---------------------------------------|---------------------------------------------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------|------|
| High Temperature storage              | Endurance test applying the high storage temperature for a long time.                                                           | +80°C , 48hrs                                                                       | 2    |
| Low Temperature storage               | Endurance test applying the low storage temperature for a long time.                                                            | -30°C , 48hrs                                                                       | 1,2  |
| High Temperature Operation            | Endurance test applying the electric stress (voltage & current) and the high thermal stress for a long time.                    | +70°C 48hrs                                                                         | 2    |
| Low Temperature Operation             | Endurance test applying the electric stress (voltage & current) and the low thermal stress for a long time.                     | -20°C , 48hrs                                                                       | 1,2  |
| High Temperature / Humidity Operation | Endurance test applying the electric stress (voltage & current) and the high thermal with high humidity stress for a long time. | +40°C , 90% RH , 48hrs                                                              | 1,2  |
| Thermal Shock resistance              | Endurance test applying the electric stress (voltage & current) during a cycle of low and high thermal stress.                  | -0°C,30min -> 25°C,5min -> 50°C,30min = 1 cycle<br>10 cycles                        |      |
| Vibration test                        | Endurance test applying vibration to simulate transportation and use.                                                           | 10-55Hz , 15mm amplitude.<br>60 sec in each of 3 directions X,Y,Z<br>For 15 minutes | 3    |
| Static electricity test               | Endurance test applying electric static discharge.                                                                              | VS=800V, RS=1.5kΩ, CS=100pF<br>One time                                             |      |

**Note 1:** No condensation to be observed.

**Note 2:** Conducted after 4 hours of storage at 25°C, 0%RH.

**Note 3:** Test performed on product itself, not inside a container.

## Precautions for using LCDs/LCMs

See Precautions at [www.newhavendisplay.com/specs/precautions.pdf](http://www.newhavendisplay.com/specs/precautions.pdf)

## Warranty Information and Terms & Conditions

[http://www.newhavendisplay.com/index.php?main\\_page=terms](http://www.newhavendisplay.com/index.php?main_page=terms)