

# NHD-C12864WO-B1TGH#-M

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

|         |   |
|---------|---|
| NHD-    | Newhaven Display                                    |
| C12864- | 128 x 64 pixels                                     |
| WO-     | Display Type: COG                                   |
| B1-     | Model   |
| T-      | White LED backlight                                 |
| G-      | STN- Gray   |
| H-      | Transflective, Wide Temp (-20°C ~ +70°C), 6:00 view |
| #-M-    | Mounting Holes                                      |
|         | <b>RoHS Compliant</b>                               |

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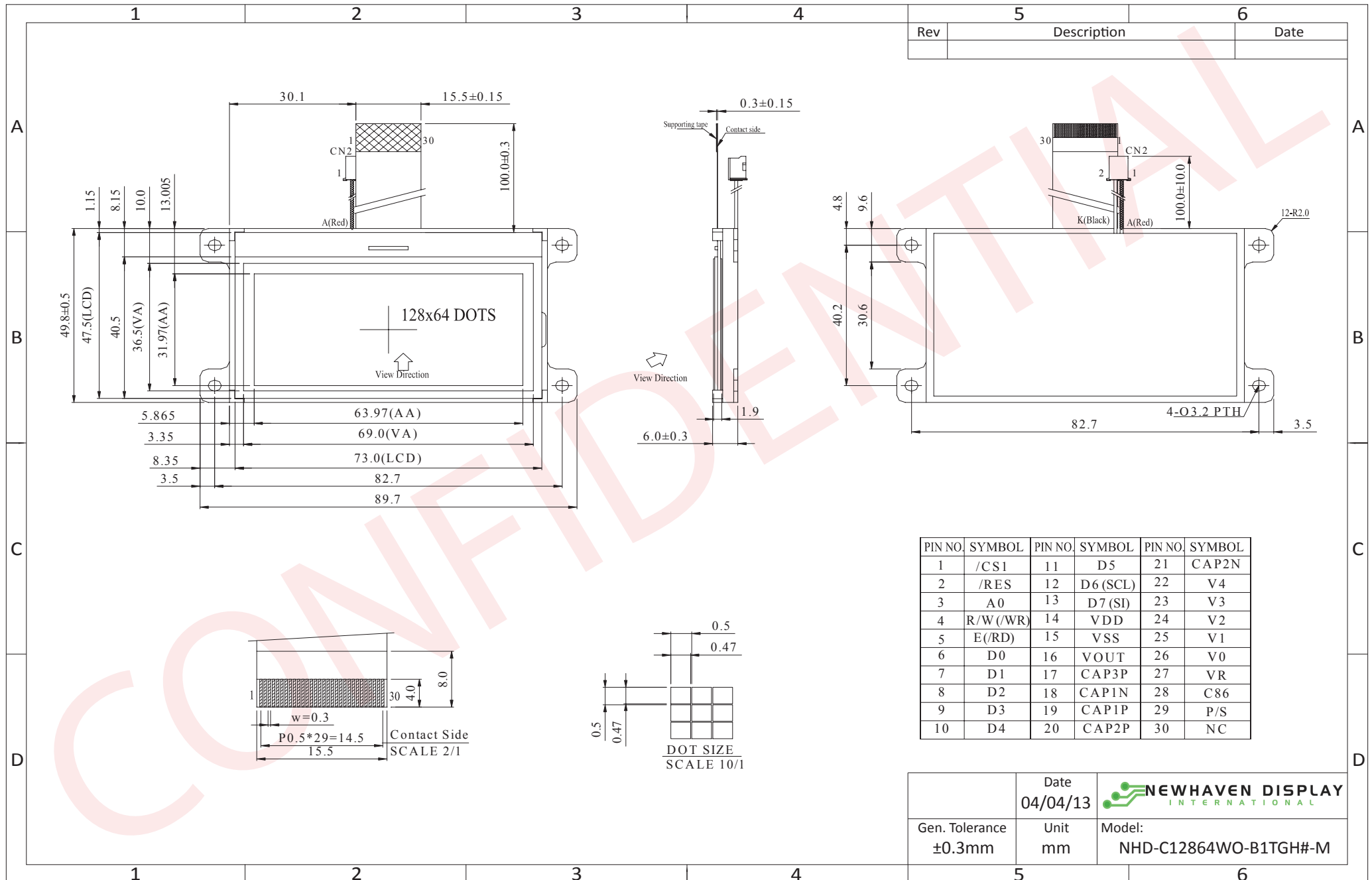
## Document Revision History

| Revision | Date      | Description  | Changed by |
|----------|-----------|--|------------|
| 0        | 9/1/2008  | Initial Release  | -          |
| 1        | 2/26/2010 | User guide reformat                                    | MC         |
| 2        | 3/9/2010  | Block diagram updated                                  | BE         |
| 3        | 5/4/2010  | Block diagram and pin description                      | MP         |
| 4        | 5/5/2010  | Backlight Connectors updated                           | BE         |
| 5        | 5/14/2010 | Pin description update                                 | MP         |
| 6        | 5/2/2011  | Example initialization code updated                    | AK         |
| 7        | 5/13/2011 | Block diagram updated                                  | AK         |
| 8        | 5/19/2011 | Block diagram & Pin description updated                | AK         |
| 9        | 1/10/2012 | Pin description & Controller link updated              | AK         |
| 10       | 6/15/2012 | Timing characteristics updated                         | AK         |
| 11       | 4/4/2013  | Backlight mating connector, LCD voltage levels updated | AK         |

## Functions and Features

- 128 x 64 pixels
- Built-in ST7565P-G controller
- +3.3V power supply
- 1/65 duty cycle; 1/9 bias
- RoHS Compliant

# Mechanical Drawing



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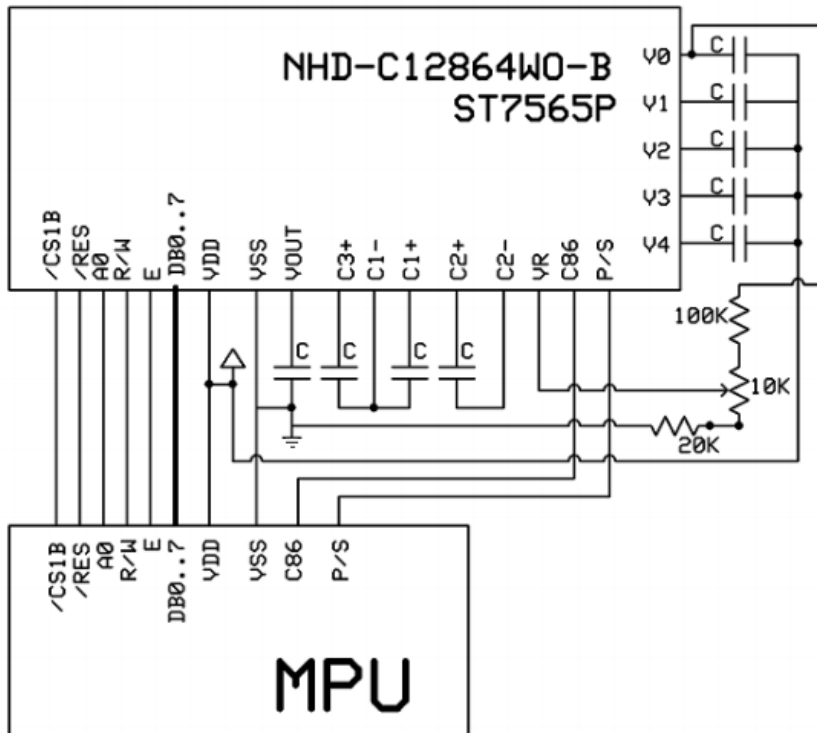
## Pin Description and Wiring Diagram

| 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 (/WR) | MPU                 | Read/write select signal. R/W=1: Read R/W=0: Write   |
| 5       | E (/RD)   | MPU                 | Operation enable signal. Falling edge triggered.   |
| 6-13    | DB0~DB7   | MPU                 | In parallel interface: 8-bit-directional data bus<br>In serial interface: DB0~DB5 = VDD or NC<br>D6 = Serial clock<br>D7 = Serial data |
| 14      | VDD       | Power Supply        | Power supply for logic (+3.3V)   |
| 15      | VSS       | Power Supply        | Ground   |
| 16      | VOUT      | Power Supply        | 2.2uF cap to VSS   |
| 17      | CAP3P     | Power Supply        | 2.2uF cap to CAP1N (pin-18)  |
| 18      | CAP1N     | Power Supply        | 2.2uF cap to CAP3P (pin-17) and CAP1P (pin-19)   |
| 19      | CAP1P     | Power Supply        | 2.2uF cap to CAP1N (pin-18)  |
| 20      | CAP2P     | Power Supply        | 2.2uF cap to CAP2N (pin-21)  |
| 21      | CAP2N     | Power Supply        | 2.2uF cap to CAP2P (pin-20)  |
| 22-26   | V4~V0     | Power Supply        | 2.2uF cap to VDD or VSS  |
| 27      | VR        | Adj Power Supply    | Wiper of 10kΩ pot (see schematic below)  |
| 28      | C86       | MPU                 | Select MPU interface pin. C86= H:6800; C86= L:8080   |
| 29      | P/S       | MPU                 | Parallel/Serail select. PS= H: Parallel; PS= L: Serial   |
| 30      | NC        | -                   | No connect   |

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

**Backlight connector:** A2001H-02P

**Mates with:** A2001WR-2P, A2001WR-S-2P, A2001WV-2P, A2001WV-S-2P



## 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     | V    |
| Supply Current              | IDD    | Ta=25°C, VDD=3.3V | -       | 0.6  | 2.0     | mA   |
| Supply for LCD (contrast)   | VDD-V0 | Ta=25°C           | 9.2     | 9.45 | 9.7     | V    |
| "H" Level input             | Vih    |                   | 0.8*VDD | -    | VDD     | V    |
| "L" Level input             | Vil    |                   | VSS     | -    | 0.2*VDD | V    |
| "H" Level output            | Voh    |                   | 0.8*VDD | -    | VDD     | V    |
| "L" Level output            | Vol    |                   | VSS     | -    | 0.2*VDD | V    |
| LED Backlight voltage       | VLED   |                   | 3.4     | 3.5  | 3.6     | V    |
| LED Backlight current       | ILED   | VLED=3.5V         | 61.2    | 72   | 100     | mA   |

## Optical Characteristics

| Item                   | Symbol | Condition | Min. | Typ. | Max. | Unit |
|------------------------|--------|-----------|------|------|------|------|
| Viewing Angle – Top    |        | CR ≥ 2    | -    | 20   | -    | °    |
| Viewing Angle – Bottom |        |           | -    | 40   | -    | °    |
| Viewing Angle – Left   |        |           | -    | 40   | -    | °    |
| Viewing Angle – Right  |        |           | -    | 40   | -    | °    |
| Contrast Ratio         | CR     |           | -    | 5    | -    | -    |
| Response Time (rise)   | Tr     |           | -    | 100  | 280  | ms   |
| Response Time (fall)   | Tf     |           | -    | 180  | 330  | ms   |

## Controller Information

Built-in ST7565P-G controller

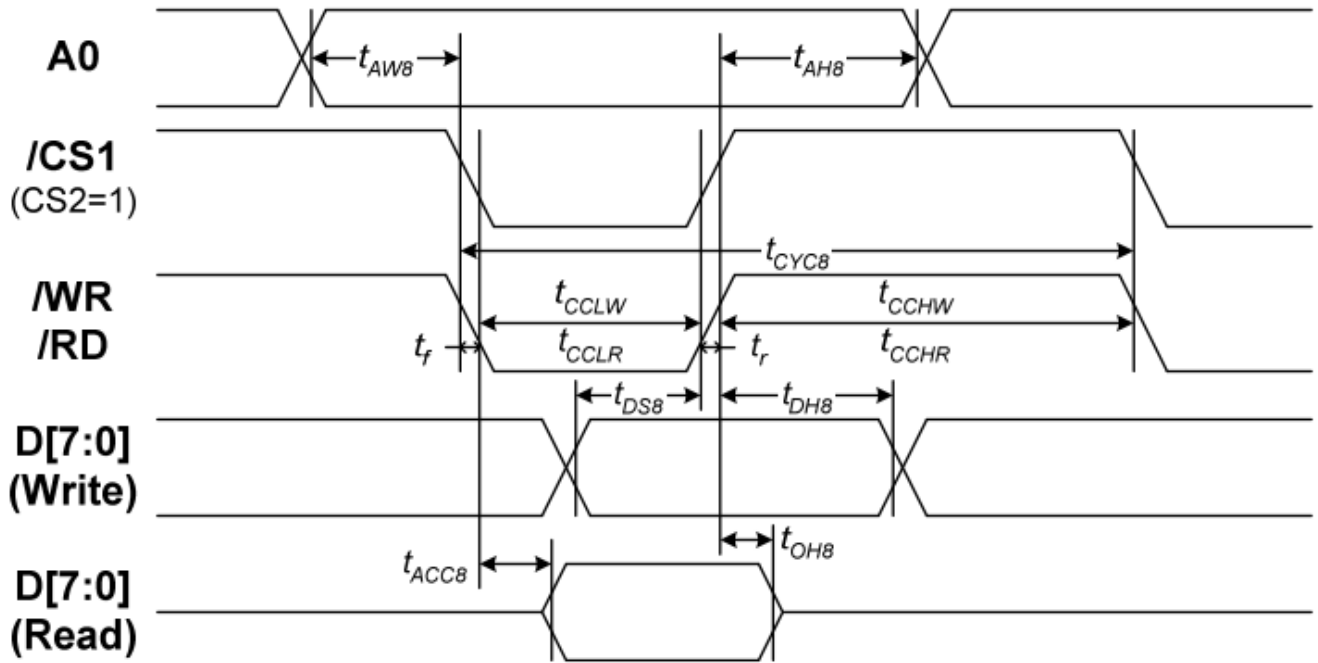
Please download specification at [http://www.newhavendisplay.com/app\\_notes/ST7565P.pdf](http://www.newhavendisplay.com/app_notes/ST7565P.pdf)

## Table of Commands

| Command   | Command 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   | LCD display ON/OFF<br>0: OFF, 1: ON   |
| (2) Display start line set  | 0            | 1   | 0   | 0          | 1  | Display start address   |    |                                  |                |    |          | 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.<br>Sets the least 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 |                |    |          |   |   |
| (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        | 1   | 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        | 1   | 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        | 1   | 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        | 1   | Sets the LCD drive voltage bias ratio<br>0: 1/9 bias, 1: 1/7 bias (ST7565P)     |
| (12) Read/modify/write  | 0            | 1   | 0   | 1          | 1  | 1                       | 0  | 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                                | 1              | *  | *        | *   | 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>0</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  | 0        | 1   | Set the V <sub>0</sub> output voltage electronic volume register                |
| Electronic volume register set                                    |              |     |     | 0          | 0  | Electronic volume value |    |                                  |                |    |          |   |   |
| (20) Booster ratio set  | 0            | 1   | 0   | 1          | 1  | 1                       | 1  | 1                                | 0              | 0  | 0        | 0   | select booster ratio<br>00: 2x,3x,4x<br>01: 5x<br>11: 6x                        |
| (21) Power saver  |              |     |     |            |    |                         |    |                                  |                |    |          |   | Display OFF and display all points ON compound command                          |
| (22) NOP  | 0            | 1   | 0   | 1          | 1  | 1                       | 0  | 0                                | 0              | 1  | 1        |   | Command for non-operation   |
| (23) Test   | 0            | 1   | 0   | 1          | 1  | 1                       | 1  | *                                | *              | *  | *        |   | Command for IC test. Do not use this command                                    |

# Timing Characteristics

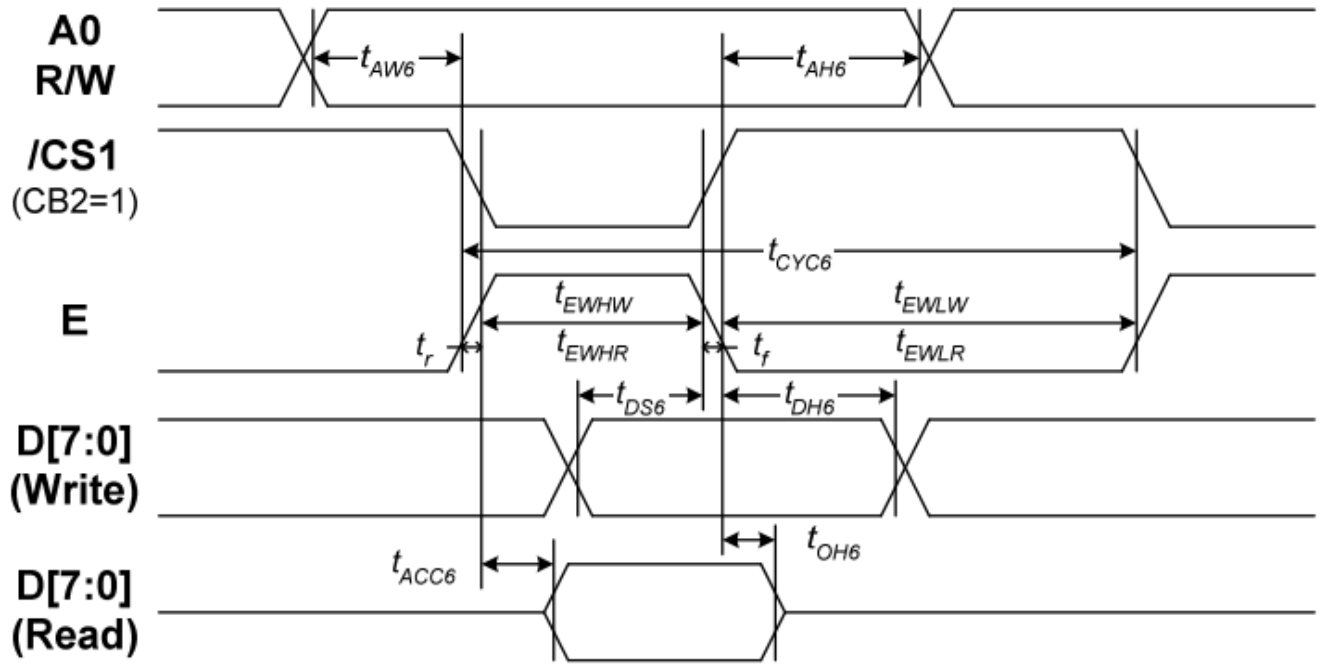
## System Bus Read/Write Characteristics 1 (For the 8080 Series MPU)



(V<sub>DD</sub> = 3.3V, T<sub>a</sub> = -30 to 85°C)

| Item                     | Signal   | Symbol            | Condition   | Rating |      | Units |
|--------------------------|----------|-------------------|-------------|--------|------|-------|
|                          |          |                   |             | Min.   | Max. |       |
| Address hold time        | A0       | t <sub>AH8</sub>  |             | 0      | —    | Ns    |
| Address setup time       |          | t <sub>AW8</sub>  |             | 0      | —    |       |
| System cycle time        |          | t <sub>CYC8</sub> |             | 240    | —    |       |
| Write L pulse width      | /WR      | t <sub>CCLW</sub> |             | 80     | —    |       |
| Write H pulse width      |          | t <sub>CCHW</sub> |             | 80     | —    |       |
| Read L pulse width       | /RD      | t <sub>CCLR</sub> |             | 140    | —    |       |
| Read H pulse width       |          | t <sub>CCHR</sub> |             | 80     | —    |       |
| Write Data setup time    | D0 to D7 | t <sub>DS8</sub>  |             | 40     | —    |       |
| Write Address hold time  |          | t <sub>DH8</sub>  |             | 0      | —    |       |
| Read access time         |          | t <sub>ACC8</sub> | CL = 100 pF | —      | 70   |       |
| Read Output disable time |          | t <sub>OH8</sub>  | CL = 100 pF | 5      | 50   |       |

## System Bus Read/Write Characteristics 2 (For the 6800 Series MPU)

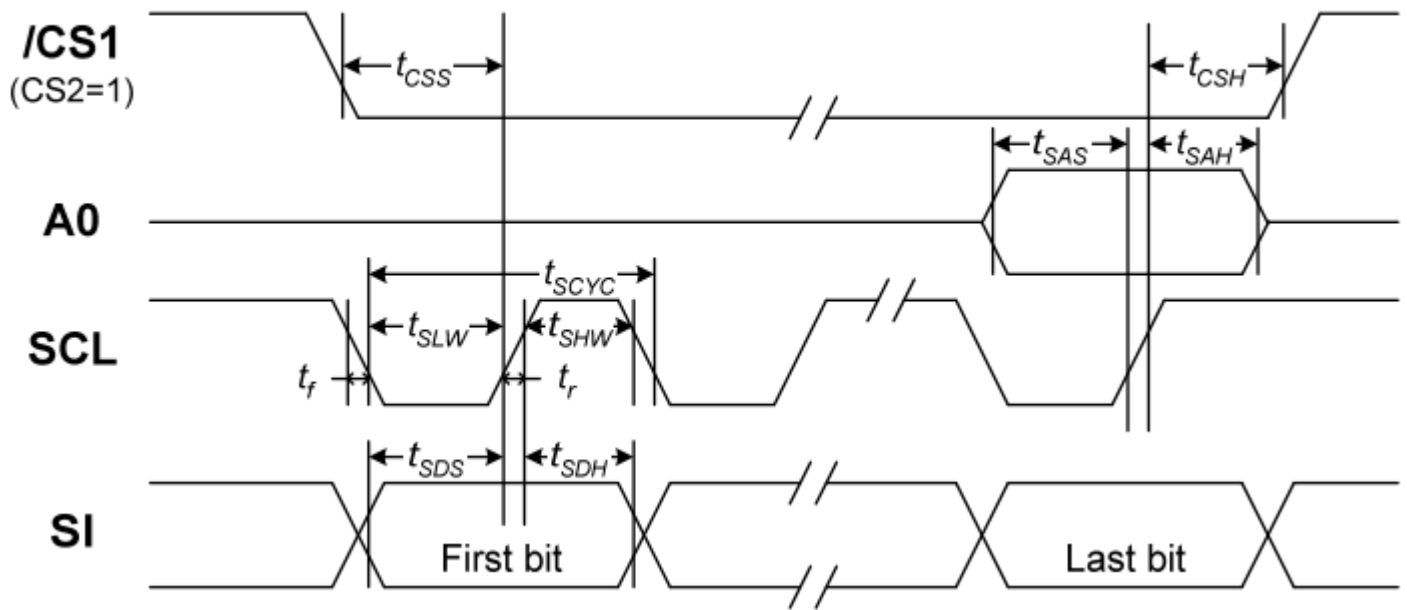


( $V_{DD} = 3.3V$ ,  $T_a = -30$  to  $85^\circ C$ )

| Item                         | Signal   | Symbol      | Condition      | Rating |      | Units |
|------------------------------|----------|-------------|----------------|--------|------|-------|
|                              |          |             |                | Min.   | Max. |       |
| Address hold time            | A0       | $t_{AH6}$   |                | 0      | —    | ns    |
| Address setup time           |          | $t_{AW6}$   |                | 0      | —    |       |
| System cycle time            |          | $t_{CYC6}$  |                | 240    | —    |       |
| Enable L pulse width (WRITE) | E        | $t_{EHLW}$  |                | 80     | —    |       |
| Enable H pulse width (WRITE) |          | $t_{EHWLW}$ |                | 80     | —    |       |
| Enable L pulse width (READ)  |          | $t_{EHLR}$  |                | 80     | —    |       |
| Enable H pulse width (READ)  |          | $t_{EHWLR}$ |                | 140    | —    |       |
| WRITE Data setup time        | D0 to D7 | $t_{DS6}$   |                | 40     | —    |       |
| WRITE Address hold time      |          | $t_{DH6}$   |                | 0      | —    |       |
| READ access time             |          | $t_{ACC6}$  | $C_L = 100$ pF | —      | 70   |       |
| READ Output disable time     |          | $t_{OH6}$   | $C_L = 100$ pF | 5      | 50   |       |



## The Serial Interface



( $V_{DD} = 3.3V$ ,  $T_a = -30$  to  $85^\circ C$ )

| Item                | Signal | Symbol     | Condition | Rating |      | Units |
|---------------------|--------|------------|-----------|--------|------|-------|
|                     |        |            |           | Min.   | Max. |       |
| Serial Clock Period | SCL    | $t_{SCYC}$ |           | 50     | —    | ns    |
| SCL "H" pulse width |        | $t_{SHW}$  |           | 25     | —    |       |
| SCL "L" pulse width |        | $t_{SLW}$  |           | 25     | —    |       |
| Address setup time  | A0     | $t_{SAS}$  |           | 20     | —    |       |
| Address hold time   |        | $t_{SAH}$  |           | 10     | —    |       |
| Data setup time     | SI     | $t_{SDS}$  |           | 20     | —    |       |
| Data hold time      |        | $t_{SDH}$  |           | 10     | —    |       |
| CS-SCL time         | CS     | $t_{CSS}$  |           | 20     | —    |       |
| CS-SCL time         |        | $t_{CSH}$  |           | 40     | —    |       |

## Example Initialization Program

```
/******  
void comm_out(unsigned int c)  
{  
    CS1 = 0; //Active Low  
    AO = 0; //LOW = instruction  
    delay(1);  
    WRT = 0; // /WR in 8080 mode; R/W in 6800 mode  
    P1 = c;  
    delay(1);  
    WRT = 1; // /WR in 8080 mode; R/W in 6800 mode  
    CS1 = 1; //inactive  
}  
  
void data_out(unsigned int d)  
{  
    CS1 = 0; //Active Low  
    AO = 1; //High = Data  
    delay(1);  
    WRT = 0;  
    P1 = d;  
    delay(1);  
    WRT = 1;  
    CS1 = 1; //inactive  
}  
  
void init()  
{  
    //IRS pin is tied low internally - external resistor circuit must be used  
    C86 = 1;           // Interface set to 8080 mode  
    RDD = 1;          // /RD in 8080 mode; E in 6800 mode  
    WRT = 1;          // /WR in 8080 mode; R/W in 6800 mode  
    CS1 = 0;  
    RST = 1;          // /RST in 8080 mode; /RES in 6800 mode  
    RST = 0;          // /RST in 8080 mode; /RES in 6800 mode  
    delay(2);  
    RST = 1;          // /RST in 8080 mode; /RES in 6800 mode  
    delay(2);  
    comm_out(0xA2);   //added 1/9 bias  
    comm_out(0xA0);   //ADC segment driver direction (A0=Normal)  
    comm_out(0xC8);  
    comm_out(0xC0);   //COM output scan direction (C0= Normal)  
    comm_out(0x40);   //Operating Mode  
    comm_out(0x25);   //resistor ratio  
    comm_out(0x19);   //column address set upper bit  
    comm_out(0x2F);   //select internal resistor ratio  
    comm_out(0xAF);   //display ON/OFF - set to ON  
}  
/******
```

## 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 , 200hrs  | 2    |
| Low Temperature storage               | Endurance test applying the low storage temperature for a long time.  | -30°C , 200hrs  | 1,2  |
| High Temperature Operation            | Endurance test applying the electric stress (voltage & current) and the high thermal stress for a long time.                    | +70°C 200hrs  | 2    |
| Low Temperature Operation             | Endurance test applying the electric stress (voltage & current) and the low thermal stress for a long time.                     | -20°C , 200hrs  | 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. | +60°C , 90% RH , 96hrs  | 1,2  |
| Thermal Shock resistance              | Endurance test applying the electric stress (voltage & current) during a cycle of low and high thermal stress.                  | -20°C,30min -> 25°C,5min -> 70°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)

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