

# NHD-C12865BR-FSW-GBW

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

|         |                          |
|---------|--------------------------|
| NHD-    | Newhaven Display         |
| C12865- | 128 x 65 Pixels          |
| BR-     | Model                    |
| F-      | Transflective            |
| SW-     | Side White LED Backlight |
| G-      | STN Gray (+)             |
| B-      | 6:00 Optimal View        |
| W-      | Wide Temperature         |
|         | <b>RoHS Compliant</b>    |

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## Document Revision History

| Revision | Date       | Description                                  | Changed by |
|----------|------------|----------------------------------------------|------------|
| 0        | 9/12/2011  | Initial Release                              | -          |
| 1        | 11/26/2012 | Backlight connector information updated      | AK         |
| 2        | 4/23/2013  | LCD backlight connector changed to A2001H-2P | AK         |
| 3        | 4/13/2015  | LCD redesigned                               | AK         |
| 4        | 7/8/2015   | Mechanical drawing updated                   | AK         |

## Functions and Features

- 128 x 65 pixels
- Built-in ST7565R controller
- +3.3V power supply
- 1/65 duty cycle; 1/9 bias
- Parallel/Serial Interface
- RoHS Compliant

1 2 3 4 5 6

Rev Description Date

A

B

C

D

66.30±0.2(B/L)  
64.50±0.2(LCD)  
60.10(V.A)MIN  
56.28(A.A)  
36.30  
(3.10)  
(5.01)  
0.80  
(3.20)  
(4.54)  
39.30±0.2(LCD)  
34.50(V.A)MIN  
31.82(A.A)  
12.00  
49.80±0.2(B/L)  
46.90±0.2(LCD)  
37.90±0.5  
2-5.00  
40.00±1.0  
6.00±0.5  
25.40±0.5  
15.50±0.1  
10.00±2.0  
2-4.95  
3.50  
(20.45)  
VIEWING DIRECTION 6 O'CLOCK  
DOTS:128X65  
28# RED  
AWG  
100±2.0  
30  
1  
A K

2.00(LCD)  
0.70±0.07  
0.70±0.07  
5.90MAX  
1.00  
3.50  
10.95  
12.00  
18.40  
4.95  
TOP GLASS  
Stiffener  
CONTACT SIDE  
A2001H-2P  
0.3±0.05  
COM51  
COM63  
COM52  
SEG0  
SEG127  
COM & SEG LAYOUT  
0.46  
0.40  
0.03  
0.04  
DOTS Detail:10:1

NHD-C12865BR-FSW-GBW  
BLACK TAPE  
W=0.30  
P=0.50  
0.50±0.1  
P:0.5X(30-1)=14.50±0.1  
4.00±0.3  
1  
30

1 /CS1  
2 /RES  
3 A0  
4 /WR  
5 /RD  
6 D0  
7 D1  
8 D2  
9 D3  
10 D4  
11 D5  
12 D6  
13 D7  
14 VDD  
15 VSS  
16 VOUT  
17 CAP3+  
18 CAP1-  
19 CAP1+  
20 CAP2+  
21 CAP2-  
22 V1  
23 V2  
24 V3  
25 V4  
26 V5  
27 VR  
28 C86  
29 PS  
30 IRS

NOTES:  
1.DISPLAY TYPE: STN/POSITIVE/GRAY  
2.POLARIZER MODE: TRANSLFLECTIVE  
3.OPERATING TEMP: -20°C~+70°C  
4.STORAGE TEMP: -30°C~+80°C  
5.LCD DRIVER IC : ST7565R  
6.VLCD: 9.5V

BACKLIGHT:4-LED(WHITE)  
IF=60 80mA VF:3.2±0.2V(TYFE)

Gen. Tolerance  
±0.3mm

Date  
07/08/15

Unit  
mm

Model:  
NHD-C12865BR-FSW-GBW

NEWHAVEN DISPLAY  
INTERNATIONAL

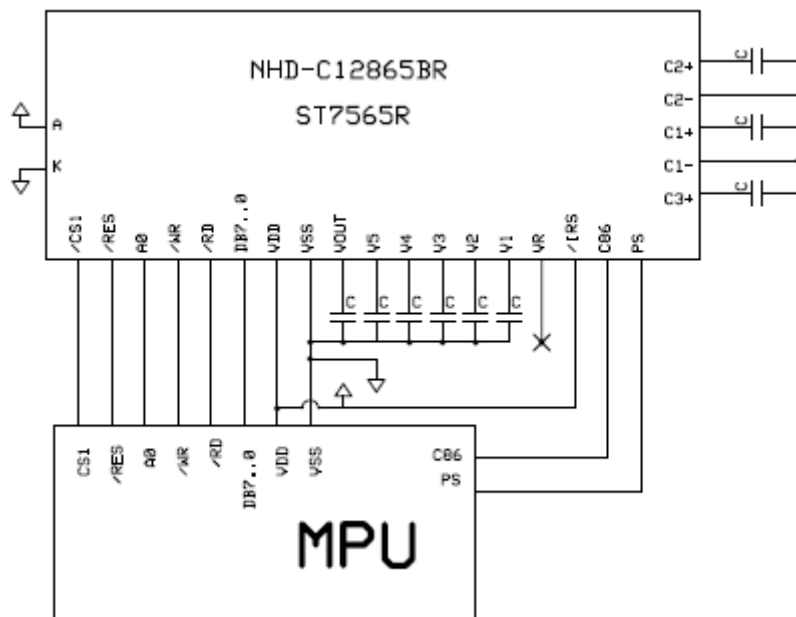
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## Pin Description and Wiring Diagram

| Pin No. | Symbol     | External Connection | Function Description                                                                                                                                                                       |
|---------|------------|---------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 1       | /CS1       | MPU                 | Active LOW Chip Select signal                                                                                                                                                              |
| 2       | /RES       | MPU                 | Active LOW Reset signal                                                                                                                                                                    |
| 3       | A0         | MPU                 | Register Select signal. A0=1: Data, A0=0: Command                                                                                                                                          |
| 4       | R/W<br>/WR | MPU                 | 6800 Mode: Read/Write select signal. R/W=1: Read R/W=0: Write<br>8080 Mode: Active LOW Write signal                                                                                        |
| 5       | E<br>/RD   | MPU                 | 6800 Mode: Active HIGH Enable signal<br>8080 Mode: Active LOW Read signal                                                                                                                  |
| 6       | DB0        | MPU                 | Parallel Interface<br>DB0-DB7: Bi-directional 8-bit data bus<br><br>Serial Interface:<br>DB0-DB5: No connect<br>DB6= Serial Clock Input signal (SCL)<br>DB7= Serial Data Input signal (SI) |
| 7       | DB1        | MPU                 |                                                                                                                                                                                            |
| 8       | DB2        | MPU                 |                                                                                                                                                                                            |
| 9       | DB3        | MPU                 |                                                                                                                                                                                            |
| 10      | DB4        | MPU                 |                                                                                                                                                                                            |
| 11      | DB5        | MPU                 |                                                                                                                                                                                            |
| 12      | DB6/SCL    | MPU                 |                                                                                                                                                                                            |
| 13      | DB7/SI     | MPU                 |                                                                                                                                                                                            |
| 14      | VDD        | Power Supply        | Power supply for LCD and logic (+3.3V)                                                                                                                                                     |
| 15      | VSS        | Power Supply        | Ground                                                                                                                                                                                     |
| 16      | VOOUT      | Power Supply        | Connect to 1uF cap to VSS or VDD                                                                                                                                                           |
| 17      | CAP3+      | Power Supply        | Connect to 1uF Cap to CAP1- (Pin-18)                                                                                                                                                       |
| 18      | CAP1-      | Power Supply        | Connect to 1uF Cap to CAP1+(Pin-19) and CAP3+(Pin17)                                                                                                                                       |
| 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)                                                                                                                                                       |
| 22-26   | V1-V5      | Power Supply        | 1.0uF-2.2uF cap to VSS or VDD                                                                                                                                                              |
| 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                 | Set HIGH to use internal resistors for V0 voltage level adjustment                                                                                                                         |

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

**Backlight connector:** A2001H-2P **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    |                  | -       | 3.3  | -       | V    |
| Supply Current              | IDD    | Ta=25°, VDD=3.3V | -       | 1.5  | 2.5     | mA   |
| Supply for LCD (contrast)   | VLCD   | Ta =25°C         | -       | 9.5  | 10      | V    |
| "H" Level input             | Vih    |                  | 0.8*VDD | -    | VDD     | V    |
| "L" Level input             | Vil    |                  | 0       | -    | 0.2*VDD | V    |
| "H" Level output            | Voh    |                  | 0.8*VDD | -    | -       | V    |
| "L" Level output            | Vol    |                  | -       | -    | 0.2*VDD | V    |
| Backlight supply voltage    | VLED   |                  | -       | 3.2  | 3.4     | V    |
| Backlight supply current    | ILED   | VLED=3.2V        | -       | 60   | 80      | mA   |

## Optical Characteristics

| Item                   | Symbol | Condition | Min. | Typ. | Max. | Unit |
|------------------------|--------|-----------|------|------|------|------|
| Viewing Angle – Top    |        | Cr≥3      | -    | 25   | -    | °    |
| Viewing Angle – Bottom |        |           | -    | 45   | -    | °    |
| Viewing Angle – Left   |        |           | -    | 35   | -    | °    |
| Viewing Angle – Right  |        |           | -    | 35   | -    | °    |
| Contrast Ratio         | CR     |           | 3.0  | -    | -    | -    |
| Response Time (rise)   | Tr     | Ta=25°C   | -    | -    | 250  | ms   |
| Response Time (fall)   | Tf     | Ta=25°C   | -    | -    | 250  | ms   |

## Controller Information

Built-in ST7565R controller.

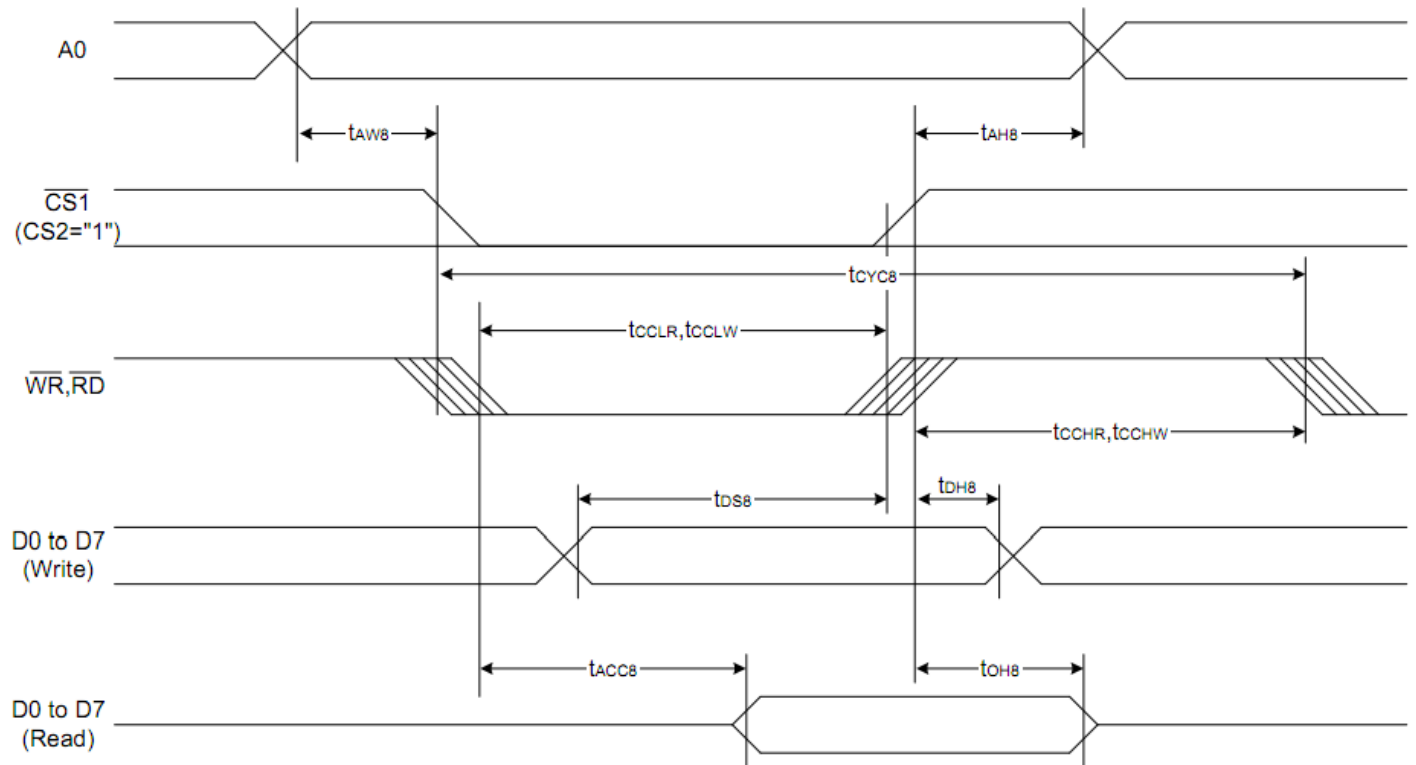
Please download specification at [http://www.newhavendisplay.com/app\\_notes/ST7565R.pdf](http://www.newhavendisplay.com/app_notes/ST7565R.pdf)

## 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                                                                                                                                           | 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<br>Column address set lower bit  | 0            | 1   | 0   | 0          | 0  | 0                     | 1  | Most significant column address<br>Least 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. |                                                                                 |
| (5) Status read                                                   | 0            | 0   | 1   | Status     |    |                       | 0  | 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 drive voltage bias ratio<br>0: 1/9 bias, 1: 1/7 bias (ST7565R)     |
| (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>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<br>Electronic volume register set | 0            | 1   | 0   | 1          | 0  | 0                     | 0  | 0                                                                   | 0              | 0  | 1                                                                                                                                           | Set the V <sub>0</sub> output voltage electronic volume register                |
| (19) Sleep mode set                                               | 0            | 1   | 0   | 1          | 0  | 1                     | 0  | 1                                                                   | 1              | 0  | 0                                                                                                                                           | 0: Sleep mode, 1: Normal mode                                                   |
| (20) Booster ratio set                                            | 0            | 1   | 0   | 1          | 1  | 1                     | 1  | 1                                                                   | 0              | 0  | 0                                                                                                                                           | select booster ratio<br>00: 2x,3x,4x<br>01: 5x<br>11: 6x                        |
| (21) NOP                                                          | 0            | 1   | 0   | 1          | 1  | 1                     | 0  | 0                                                                   | 0              | 1  | 1                                                                                                                                           | Command for non-operation                                                       |
| (22) Test                                                         | 0            | 1   | 0   | 1          | 1  | 1                     | 1  | *                                                                   | *              | *  | *                                                                                                                                           | Command for IC test. Do not use this command                                    |

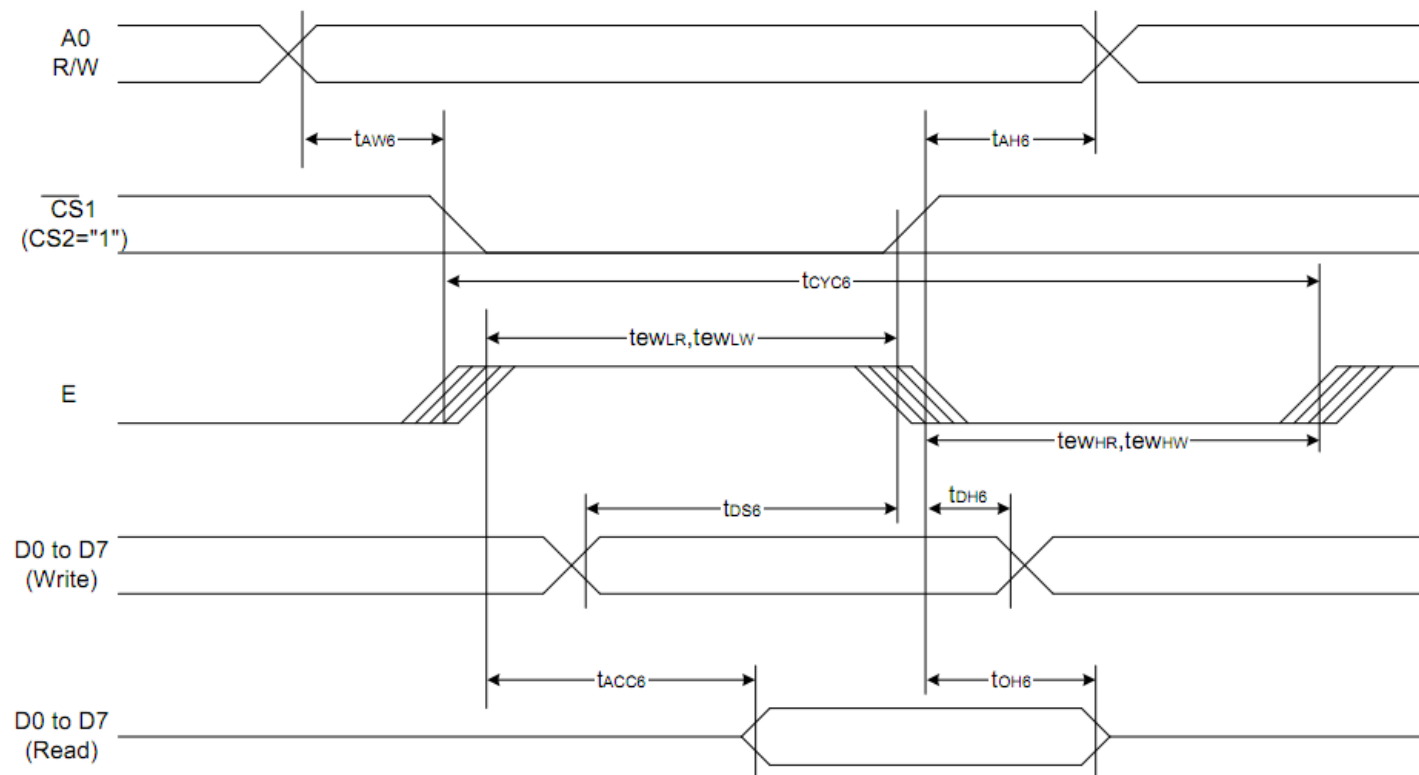
# Timing Characteristics

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



| Item                         | Signal   | Symbol     | Condition   | Rating |      | Units |
|------------------------------|----------|------------|-------------|--------|------|-------|
|                              |          |            |             | Min.   | Max. |       |
| Address hold time            | A0       | $t_{AH8}$  |             | 0      | —    | Ns    |
| Address setup time           |          | $t_{AW8}$  |             | 0      | —    |       |
| System cycle time            |          | $t_{CYC8}$ |             | 240    | —    |       |
| Enable L pulse width (WRITE) | WR       | $t_{CCLW}$ |             | 80     | —    |       |
| Enable H pulse width (WRITE) |          | $t_{CCHW}$ |             | 80     | —    |       |
| Enable L pulse width (READ)  | RD       | $t_{CCLR}$ |             | 140    | —    |       |
| Enable H pulse width (READ)  |          | $t_{CCHR}$ |             | 80     | —    |       |
| WRITE Data setup time        | D0 to D7 | $t_{DS8}$  |             | 40     | —    |       |
| WRITE Address hold time      |          | $t_{DH8}$  |             | 0      | —    |       |
| READ access time             |          | $t_{ACC8}$ | CL = 100 pF | —      | 70   |       |
| READ Output disable time     |          | $t_{OH8}$  | CL = 100 pF | 5      | 50   |       |

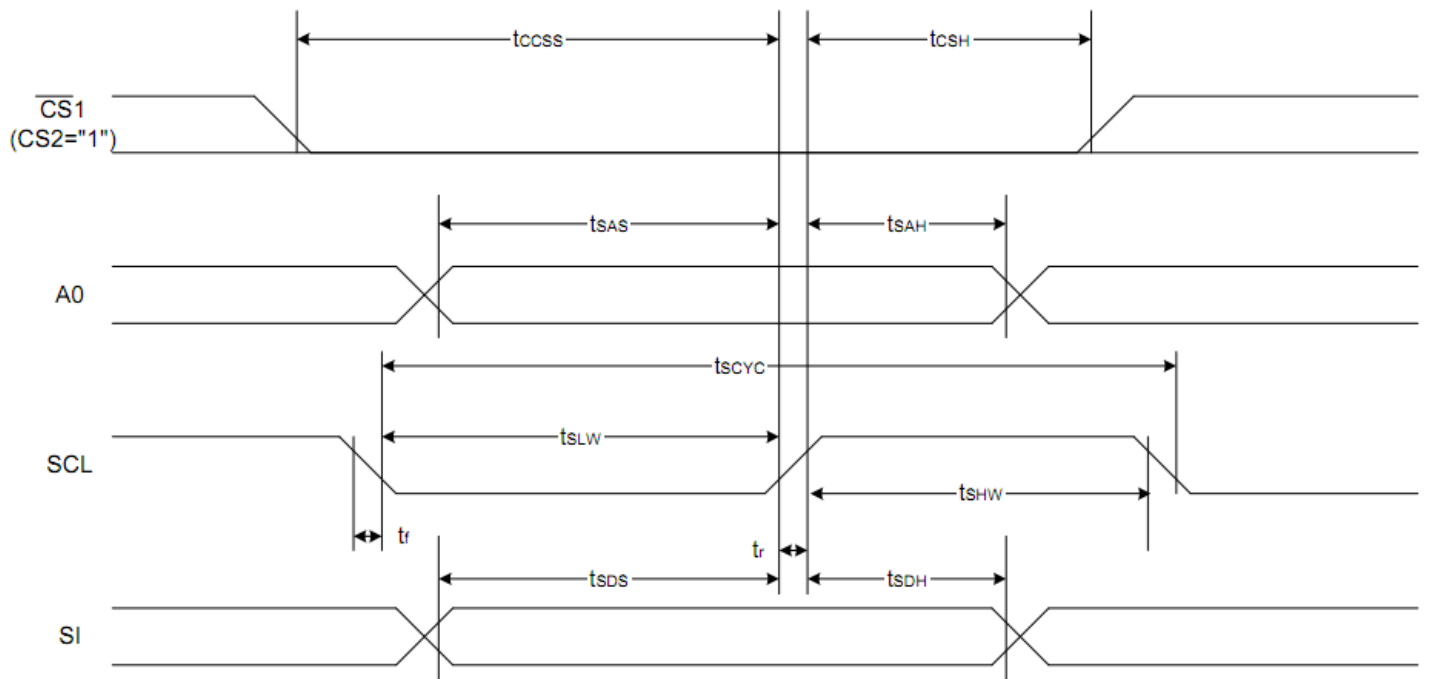
## System Bus Read/Write Characteristics 2 (For the 6800 Series MPU)



| Item                         | Signal   | Symbol | Condition   | Rating |      | Units |
|------------------------------|----------|--------|-------------|--------|------|-------|
|                              |          |        |             | Min.   | Max. |       |
| Address hold time            | A0       | tAH6   |             | 0      | —    | ns    |
| Address setup time           |          | tAW6   |             | 0      | —    |       |
| System cycle time            |          | tCYC6  |             | 240    | —    |       |
| Enable L pulse width (WRITE) | WR       | tEWLW  |             | 80     | —    |       |
| Enable H pulse width (WRITE) |          | tEWHW  |             | 80     | —    |       |
| Enable L pulse width (READ)  | RD       | tEWLR  |             | 80     | —    |       |
| Enable H pulse width (READ)  |          | tEWHR  |             | 140    | —    |       |
| WRITE Data setup time        | D0 to D7 | tDS6   |             | 40     | —    |       |
| WRITE Address hold time      |          | tDH6   |             | 0      | —    |       |
| READ access time             |          | tACC6  | CL = 100 pF | —      | 70   |       |
| READ Output disable time     |          | tOH6   | CL = 100 pF | 5      | 50   |       |



## The 4-line SPI Interface



| Item                    | Signal | Symbol            | Condition | Rating |      | Units |
|-------------------------|--------|-------------------|-----------|--------|------|-------|
|                         |        |                   |           | Min.   | Max. |       |
| 4-line SPI Clock Period | SCL    | $T_{\text{scyc}}$ |           | 50     | —    | ns    |
| SCL "H" pulse width     |        | $T_{\text{shw}}$  |           | 25     | —    |       |
| SCL "L" pulse width     |        | $T_{\text{SLW}}$  |           | 25     | —    |       |
| Address setup time      | A0     | $T_{\text{SAS}}$  |           | 20     | —    |       |
| Address hold time       |        | $T_{\text{SAH}}$  |           | 10     | —    |       |
| Data setup time         | SI     | $T_{\text{sds}}$  |           | 20     | —    |       |
| Data hold time          |        | $T_{\text{SDH}}$  |           | 10     | —    |       |
| CS-SCL time             | CS     | $T_{\text{css}}$  |           | 20     | —    |       |
| CS-SCL time             |        | $T_{\text{csh}}$  |           | 40     | —    |       |

## Example Initialization Program

```
/******
```

```
Sub Command  
Reset P3.7  
Reset P3.4  
Reset P3.1  
P1 = A  
Set P3.1  
Set P3.7  
End Sub
```

```
/******
```

```
Sub Write  
Reset P3.7  
Set P3.4  
Reset P3.1  
P1 = A  
Set P3.1  
Set P3.7  
End Sub
```

```
/******
```

```
Sub Init  
A = &HA0  
Call Command  
A = &HAE  
Call Command  
A = &HC0  
Call Command  
A = &HA2  
Call Command  
A = &H2F  
Call Command  
A = &H26  
Call Command  
A = &H81  
Call Command  
A = &H2F  
Call Command  
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)