

NHD-C12864WC-FSW-FBW-3V3-M

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

| | |
|---------|--------------------------|
| NHD- | Newhaven Display |
| C12864- | 128 x 64 Pixels |
| WM- | Model |
| F- | Transflective |
| SW- | Side White LED Backlight |
| F- | FSTN, Positive |
| B- | 6:00 Optimal View |
| W- | Wide Temp. |
| 3V3- | 3.0V LCD, 3.0V Backlight |
| M- | Mounting Holes |
| | RoHS Compliant |

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Document Revision History

| Revision | Date | Description | Changed by |
|----------|----------|--|------------|
| 0 | 10/12/10 | Initial Release | MC |
| 1 | 5/25/10 | Electrical characteristics updated | AK |
| 2 | 4/4/13 | Backlight mating connector part number updated | AK |
| 3 | 3/16/15 | Pin Description updated | RM |
| 4 | 9/30/15 | Wiring Diagram updated, Backlight Current rating added | SB |
| 5 | 9/13/16 | Capacitor Values Adjusted | SB |
| 6 | 2/22/19 | Mechanical Drawing Updated, Supply Current Updated | SB |
| 7 | 3/3/19 | Backlight Current Updated | SB |

Functions and Features

- 128 x 64 pixels
- Built-in ST7565R controller
- Parallel/Serial interface
- 1/64 duty cycle; 1/9 bias
- RoHS Compliant

A

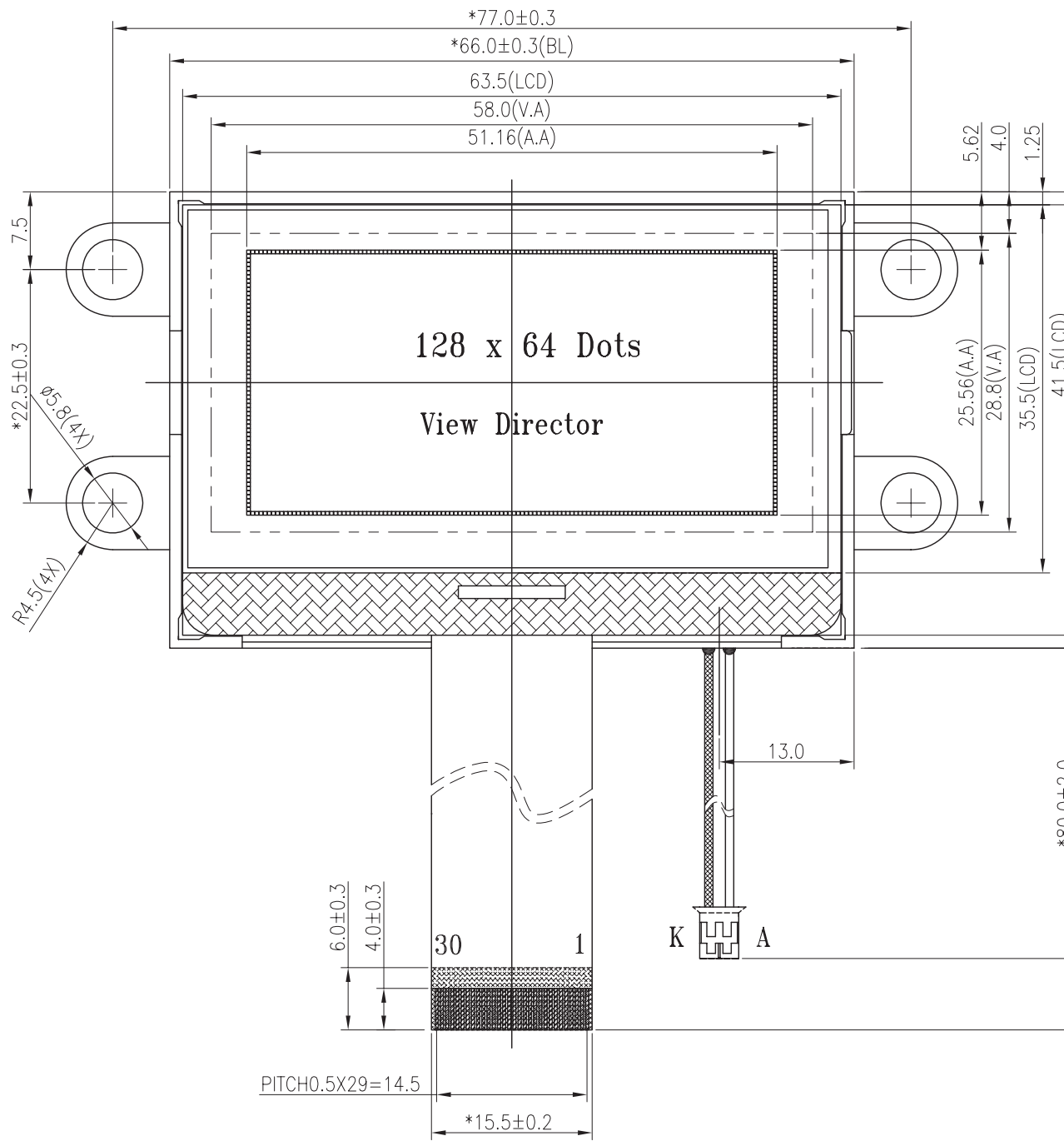
B

C

D

E

F



Notes:

- | | |
|------------------|-------------------------------|
| 1. Driver: | 1/64 Duty, 1/9 Bias |
| 2. Display Mode: | FSTN Positive / Transflective |
| 3. Optimal View: | 6:00 |
| 4. Voltage: | 3.3V VDD, 10.3V VLCD |
| 5. Backlight: | White LED |
| 6. Driver IC: | ST7565R |

1

2

3

4

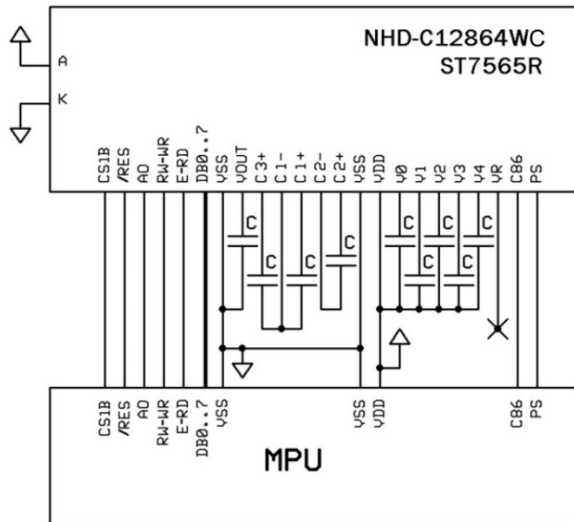
Pin Description and Wiring Diagram

| Pin No. | Symbol | External Connection | Function Description | |
|---------|------------|---------------------|--|--|
| 1 | CS1B | MPU | Active LOW chip select | |
| 2 | /RES | MPU | Active LOW Reset signal | |
| 3 | A0 | MPU | Register Select signal. A0=0: Command, A0=1: Data | |
| 4 | R/W /WR | MPU | 6800 Mode: Read/Write select signal. R/W=1: Read R/W=0: Write 8080 Mode: Active LOW Write Signal | |
| 5 | E /RD | MPU | 6800 Mode: Active HIGH Enable Signal 8080 Mode: Active LOW Read Signal | |
| 6 | DB0 | MPU | Parallel Interface DB0-DB7: Bi-directional 8-bit data bus Serial Interface: DB0-DB5: No connect in serial mode DB6 = Serial clock DB7 = Serial data | |
| 7 | DB1 | MPU | | |
| 8 | DB2 | MPU | | |
| 9 | DB3 | MPU | | |
| 10 | DB4 | MPU | | |
| 11 | DB5 | MPU | | |
| 12 | DB6(SCL) | MPU | | |
| 13 | DB7(SI) | MPU | | |
| 14 | VSS | Power Supply | | Ground (reference for voltage step-up circuit) |
| 15 | VOUT | Power Supply | | Connect capacitor to VSS (PIN-14) (1.0-2.2 μ F) |
| 16 | CAP3+ | Power Supply | | Connect capacitor to CAP1- (PIN-17) (1.0-2.2 μ F) |
| 17 | CAP1- | Power Supply | | Connect capacitor to CAP3+(PIN16) and CAP1+(PIN18) (1.0-2.2 μ F) |
| 18 | CAP1+ | Power Supply | | Connect capacitor to CAP1- (PIN-17) (1.0-2.2 μ F) |
| 19 | CAP2+ | Power Supply | Connect capacitor to CAP2- (PIN-20) (1.0-2.2 μ F) | |
| 20 | CAP2- | Power Supply | Connect capacitor to CAP2+ (PIN-19) (1.0-2.2 μ F) | |
| 21 | VSS | Power Supply | Ground | |
| 22 | VDD | Power Supply | Supply voltage for LCD and logic (3.0V) | |
| 23~27 | V4~V0 | Power Supply | 0.1 – 1.0 μ F capacitor to V _{DD} or V _{SS} | |
| 28 | VR | - | No Connect | |
| 29 | C86 | MPU | Select MPU interface pin. C86=H: 6800; C86=L: 8080 | |
| 30 | PS | MPU | Parallel/Serial Select. PS= H: Parallel; PS=L: Serial | |
| A | LED+ | Power Supply | Backlight Anode (+3.0V) | |
| K | LED- | Power Supply | Backlight Cathode (Ground) | |

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

Wiring Diagram



Electrical Characteristics

| Item | Symbol | Condition | Min. | Typ. | Max. | Unit |
|-----------------------------|-----------|------------------------|--------------------|------|--------------------|------|
| Operating Temperature Range | T_{OP} | Absolute Max | -20 | - | +70 | °C |
| Storage Temperature Range | T_{ST} | Absolute Max | -30 | - | +80 | °C |
| Supply Voltage | V_{DD} | - | 3.0 | 3.3 | 3.6 | V |
| Supply Current | I_{DD} | $V_{DD} = 3.3V$ | 0.1 | 0.32 | 1.20 | mA |
| Supply for LCD (contrast) | V_{LCD} | $T_{OP} = 25^{\circ}C$ | 10.0 | 10.3 | 10.6 | V |
| "H" Level input | V_{IH} | - | $0.8 \cdot V_{DD}$ | - | V_{DD} | V |
| "L" Level input | V_{IL} | - | V_{SS} | - | $0.2 \cdot V_{DD}$ | V |
| "H" Level output | V_{OH} | - | $0.8 \cdot V_{DD}$ | - | V_{DD} | - |
| "L" Level output | V_{OL} | - | V_{SS} | - | $0.2 \cdot V_{DD}$ | - |
| LED BKL voltage | V_{LED} | - | 2.8 | 3.0 | 3.2 | V |
| LED BKL current | I_{LED} | $V_{LED} = 3.0V$ | 21 | 36 | 55 | mA |

Optical Characteristics

| Item | Symbol | Condition | Min. | Typ. | Max. | Unit |
|------------------------|--------|------------------------|------|------|------|------|
| Optimal Viewing Angles | Top | $CR \geq 2$ | - | 20 | - | ° |
| | Bottom | | - | 40 | - | ° |
| | Left | | - | 45 | - | ° |
| | Right | | - | 45 | - | ° |
| Contrast Ratio | CR | - | 2 | 8 | - | - |
| Response Time | Rise | $T_{OP} = 25^{\circ}C$ | - | 150 | 300 | ms |
| | Fall | | - | 150 | 200 | ms |

Controller Information

Built-in ST7565R controller.

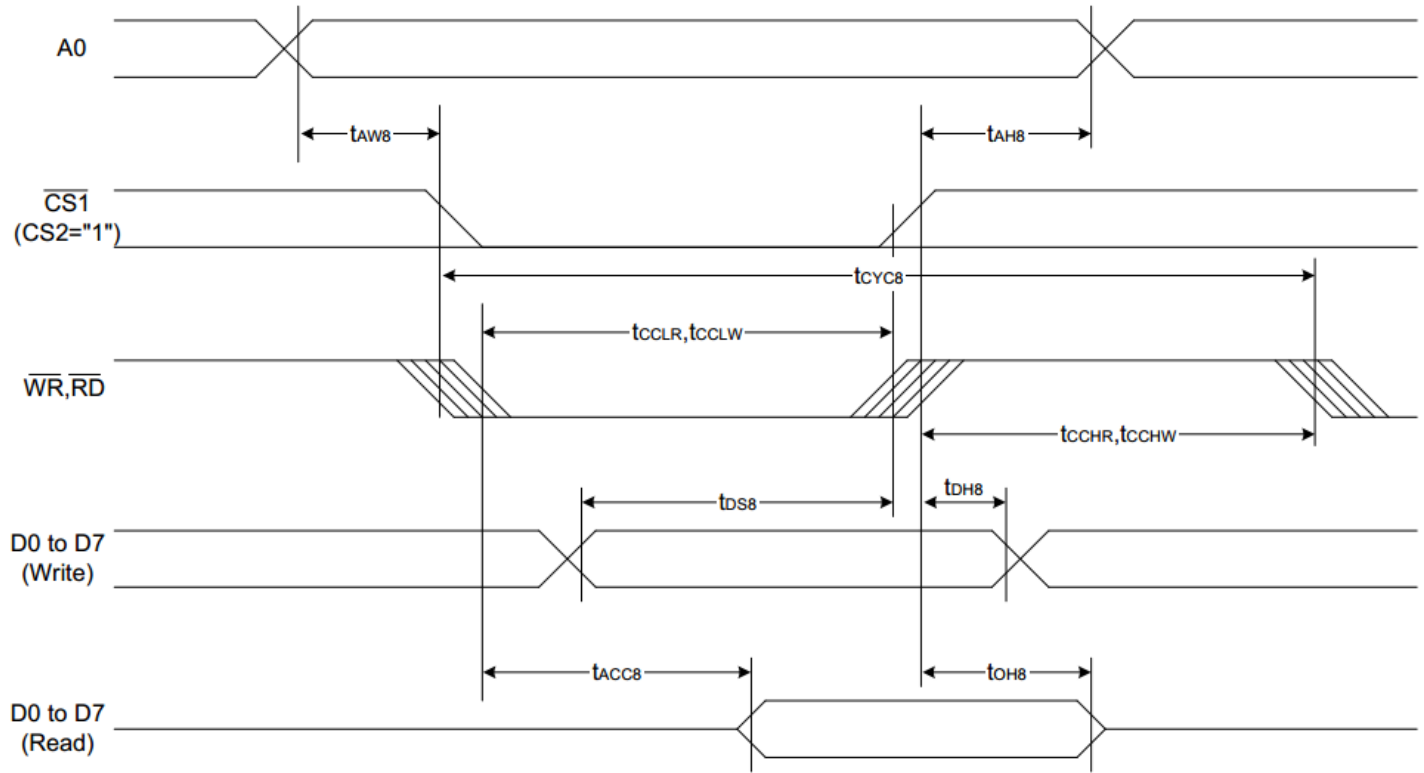
Please download specification at http://www.newhavendisplay.com/app_notes/ST7565R.pdf

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 | 1 | LCD display ON/OFF 0: OFF, 1: ON |
| (2) Display start line set | 0 | 1 | 0 | 0 | 1 | Display start address | | | | | 0 | Sets the display RAM display start line address | |
| (3) Page address set | 0 | 1 | 0 | 1 | 0 | 1 | 1 | Page address | | | | 0 | Sets the display RAM page address |
| (4) Column address set upper bit | 0 | 1 | 0 | 0 | 0 | 0 | 1 | Most significant column address | | | | 0 | Sets the most significant 4 bits of the display RAM column address. |
| Column address set lower bit | | | | 0 | 0 | 0 | 0 | Least significant column address | | | | 0 | 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 | | | | | | | 0 | Writes to the display RAM | |
| (7) Display data read | 1 | 0 | 1 | Read data | | | | | | | 0 | Reads from the display RAM | |
| (8) ADC select | 0 | 1 | 0 | 1 | 0 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | Sets the display RAM address SEG output correspondence 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 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 0: normal display 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 0: 1/9 bias, 1: 1/7 bias (ST7565R) |
| (12) Read-modify-write | 0 | 1 | 0 | 1 | 1 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | Column address increment At write: +1 At read: 0 |
| (13) End | 0 | 1 | 0 | 1 | 1 | 1 | 0 | 1 | 1 | 1 | 0 | 0 | Clear read/modify/write |
| (14) Reset | 0 | 1 | 0 | 1 | 1 | 1 | 0 | 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 0: normal direction 1: reverse direction |
| (16) Power control set | 0 | 1 | 0 | 0 | 0 | 1 | 0 | 1 | Operating mode | | | 0 | Select internal power supply operating mode |
| (17) V ₀ voltage regulator internal resistor ratio set | 0 | 1 | 0 | 0 | 0 | 1 | 0 | 0 | Resistor ratio | | | 0 | 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 ₀ output voltage electronic volume register |
| Electronic volume register set | | | | 0 | 0 | Electronic volume value | | | | | 0 | | |
| (19) Sleep mode set | 0 | 1 | 0 | 1 | 0 | 1 | 0 | 1 | 1 | 0 | 0 | 1 | 0: Sleep mode, 1: Normal mode |
| (20) Booster ratio set | 0 | 1 | 0 | 1 | 1 | 1 | 1 | 1 | 0 | 0 | 0 | 0 | select booster ratio 00: 2x,3x,4x 01: 5x 11: 6x |
| | | | | 0 | 0 | 0 | 0 | 0 | 0 | 0 | step-up value | | |
| (21) NOP | 0 | 1 | 0 | 1 | 1 | 1 | 0 | 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

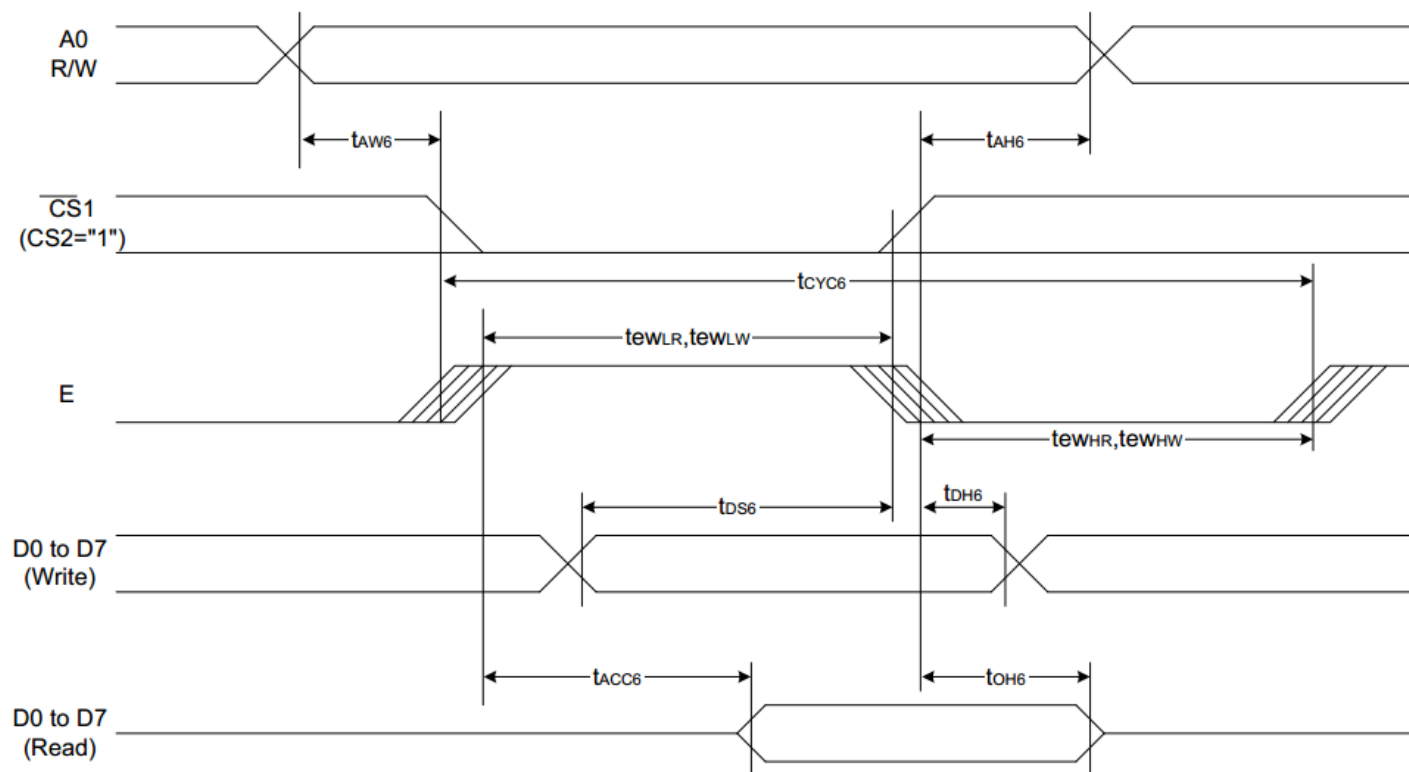
System Bus Read/Write Characteristics 1 (For the 8080 Series MPU)



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

| Item | Signal | Symbol | Condition | Rating | | Units |
|------------------------------|----------|--------|-------------|--------|------|-------|
| | | | | Min. | Max. | |
| Address hold time | A0 | tAH8 | | 0 | — | Ns |
| Address setup time | | tAW8 | | 0 | — | |
| System cycle time | | tCYC8 | | 240 | — | |
| Enable L pulse width (WRITE) | WR | tCCLW | | 80 | — | |
| Enable H pulse width (WRITE) | | tCCHW | | 80 | — | |
| Enable L pulse width (READ) | RD | tCCLR | | 140 | — | |
| Enable H pulse width (READ) | | tCCHR | | 80 | — | |
| WRITE Data setup time | D0 to D7 | tDS8 | | 40 | — | |
| WRITE Address hold time | | tDH8 | | 0 | — | |
| READ access time | | tACC8 | CL = 100 pF | — | 70 | |
| READ Output disable time | | tOH8 | CL = 100 pF | 5 | 50 | |

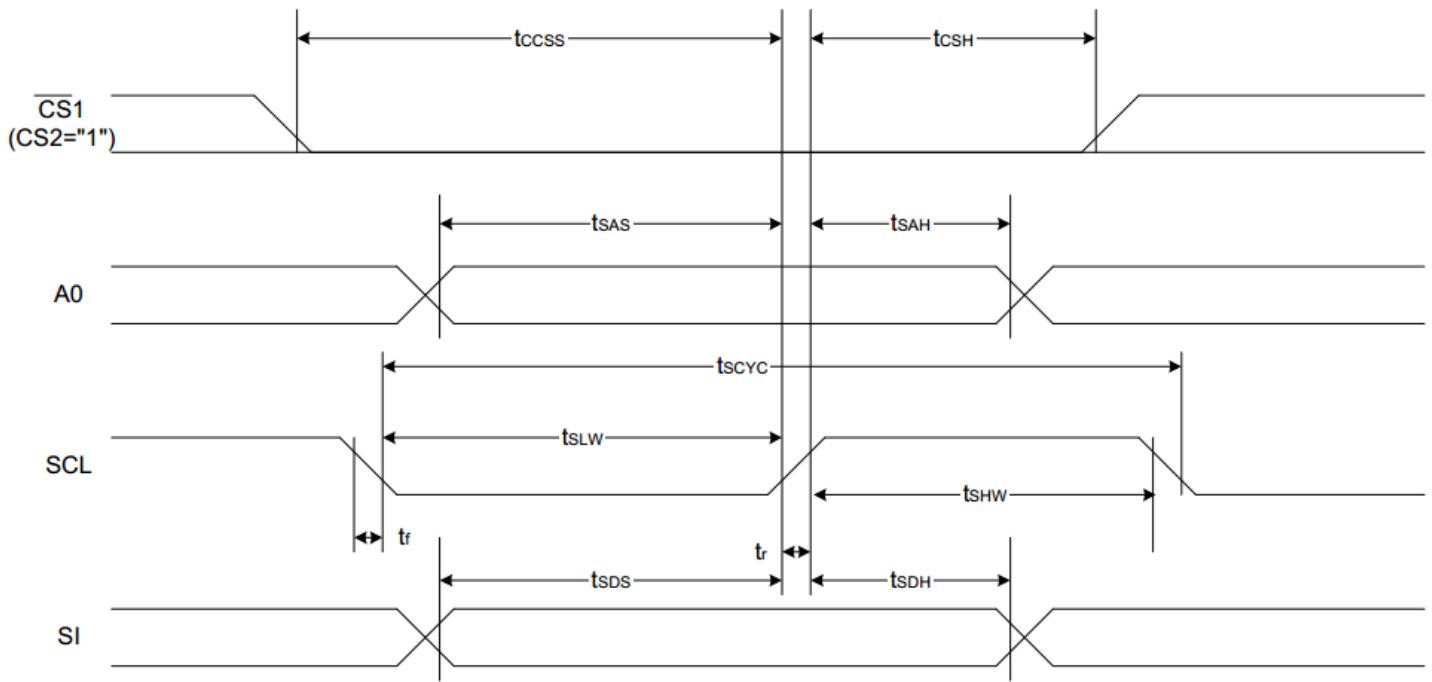
System Bus Read/Write Characteristics 2 (For the 6800 Series MPU)



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

| 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) | WR | t_{EWLW} | | 80 | — | |
| Enable H pulse width (WRITE) | | t_{EWHW} | | 80 | — | |
| Enable L pulse width (READ) | RD | t_{EWLR} | | 80 | — | |
| Enable H pulse width (READ) | | t_{EWHR} | | 140 | — | |
| WRITE Data setup time | D0 to D7 | t_{DSE} | | 40 | — | |
| WRITE Address hold time | | t_{DH6} | | 0 | — | |
| READ access time | | t_{ACC6} | $C_L = 100 \text{ pF}$ | — | 70 | |
| READ Output disable time | | t_{OH6} | $C_L = 100 \text{ pF}$ | 5 | 50 | |

The 4-line SPI Interface



($V_{\text{DD}} = 3.3\text{V}$, $T_{\text{a}} = -30$ to 85°C)

| Item | Signal | Symbol | Condition | Rating | | Units |
|-------------------------|--------|-------------------|-----------|--------|------|-------|
| | | | | Min. | Max. | |
| 4-line SPI 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

```
'-----  
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            'CS2  
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            'CS2  
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 , 240hrs | 2 |
| Low Temperature storage | Endurance test applying the low storage temperature for a long time. | -30°C , 240hrs | 1,2 |
| High Temperature Operation | Endurance test applying the electric stress (voltage & current) and the high thermal stress for a long time. | +70°C 240hrs | 2 |
| Low Temperature Operation | Endurance test applying the electric stress (voltage & current) and the low thermal stress for a long time. | -20°C , 240hrs | 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 , 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 10 cycles | |
| Vibration test | Endurance test applying vibration to simulate transportation and use. | 10-55Hz , 15mm amplitude. 60 sec in each of 3 directions X,Y,Z For 15 minutes | 3 |
| Static electricity test | Endurance test applying electric static discharge. | VS=800V, RS=1.5kΩ, CS=100pF 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

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