

NHD-C12864WO-B1TTI#-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 |
| T- | FSTN (Negative) |
| I#- | Transmissive, Wide Temp (-20°C ~ +70°C), 6:00 view |
| M- | Mounting Holes |
| | RoHS Compliant |

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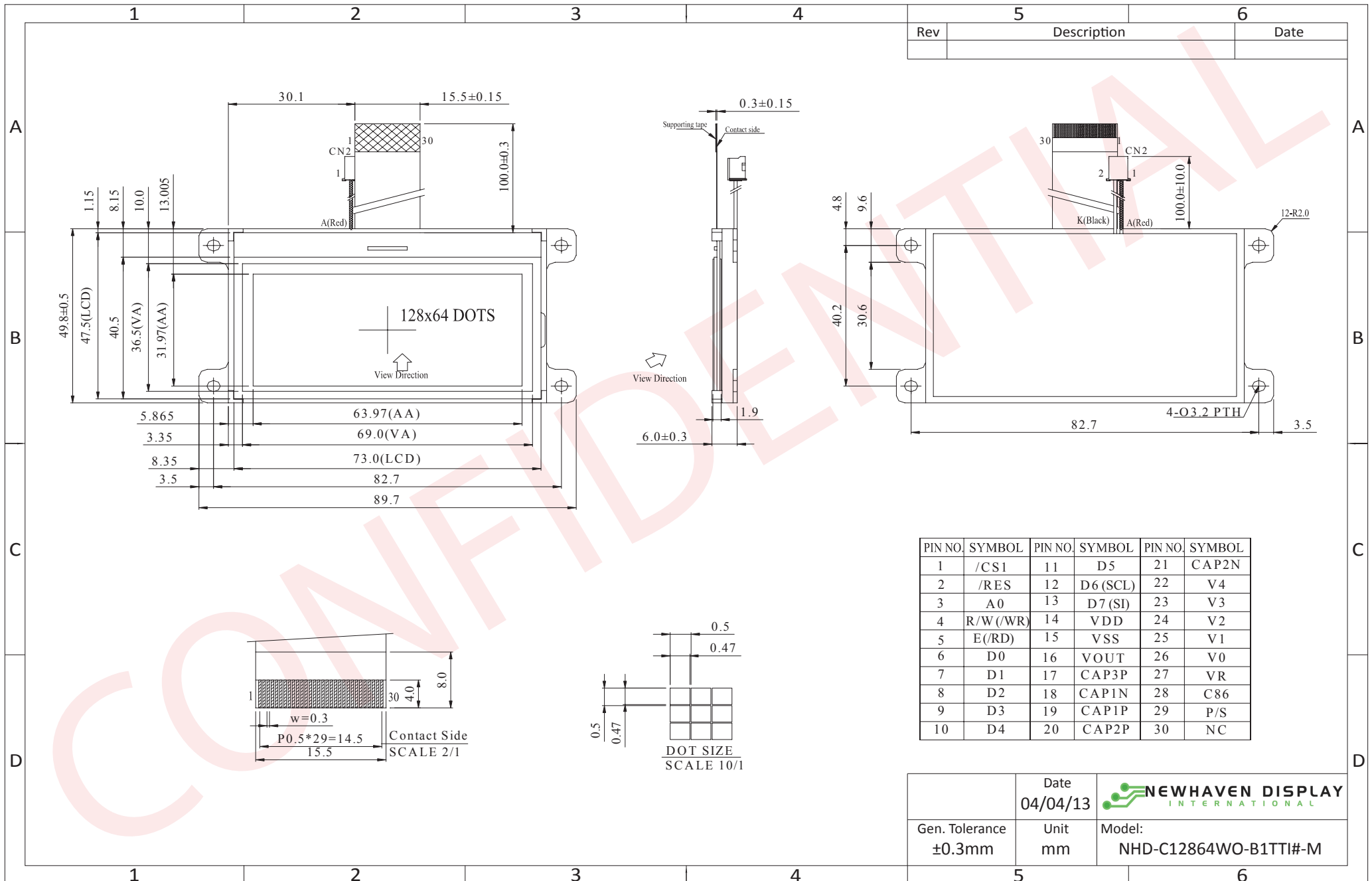
Document Revision History

| 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 update | MP |
| 4 | 5/5/2010 | Backlight connector 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 |
| 12 | 4/17/2013 | Optical characteristics updated | AK |

Functions and Features

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

Mechanical Drawing



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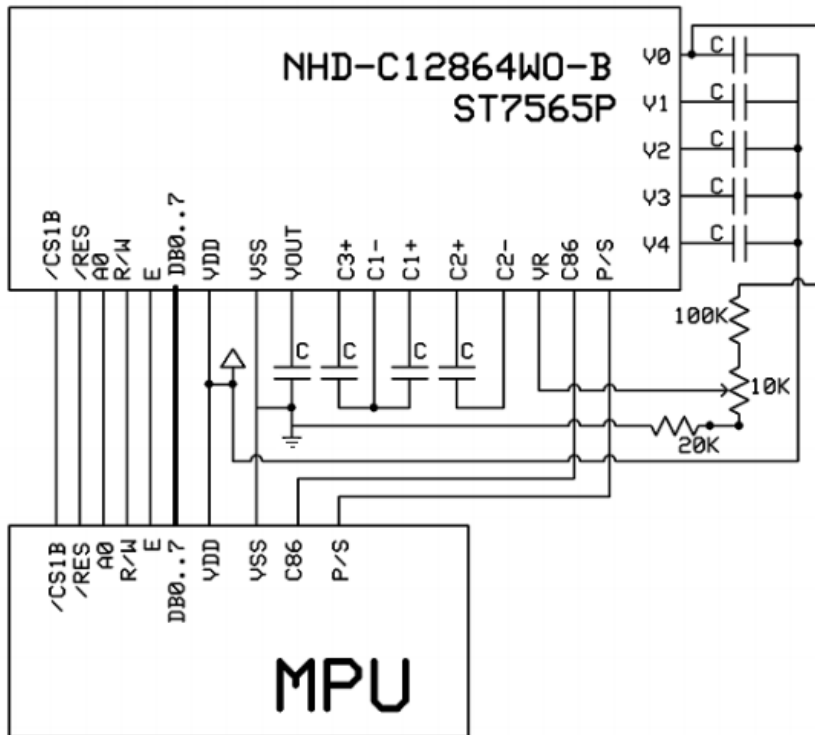
Pin Description and Wiring Diagram

| 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 In serial interface: DB0~DB5 = VDD or NC D6 = Serial clock 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/Serial 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 | | 2.7 | 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 | - | 64 | 80 | mA |

Optical Characteristics

| Item | Symbol | Condition | Min. | Typ. | Max. | Unit |
|------------------------|--------|-----------|------|------|------|------|
| Viewing Angle – Top | | Cr ≥ 2 | - | 30 | - | ° |
| Viewing Angle – Bottom | | | - | 60 | - | ° |
| Viewing Angle – Left | | | - | 45 | - | ° |
| Viewing Angle – Right | | | - | 45 | - | ° |
| Contrast Ratio | Cr | | - | 5 | - | - |
| Response Time (rise) | Tr | | - | 150 | 200 | ms |
| Response Time (fall) | Tf | | - | 150 | 200 | ms |

Controller Information

Built-in ST7565P controller

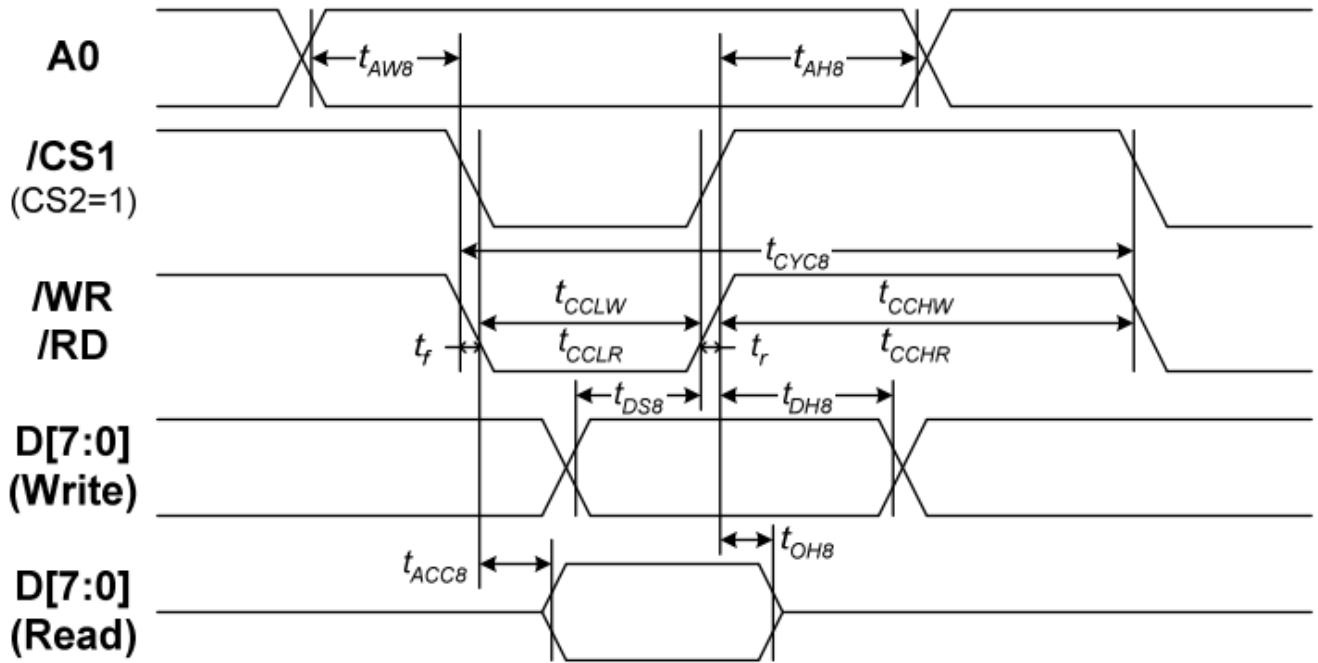
Please download specification at http://www.newhavendisplay.com/app_notes/ST7565P.pdf

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 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. 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 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 (ST7565P) |
| (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 | | 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 0: normal direction 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 ₀ 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 ₀ 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 00: 2x,3x,4x 01: 5x 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

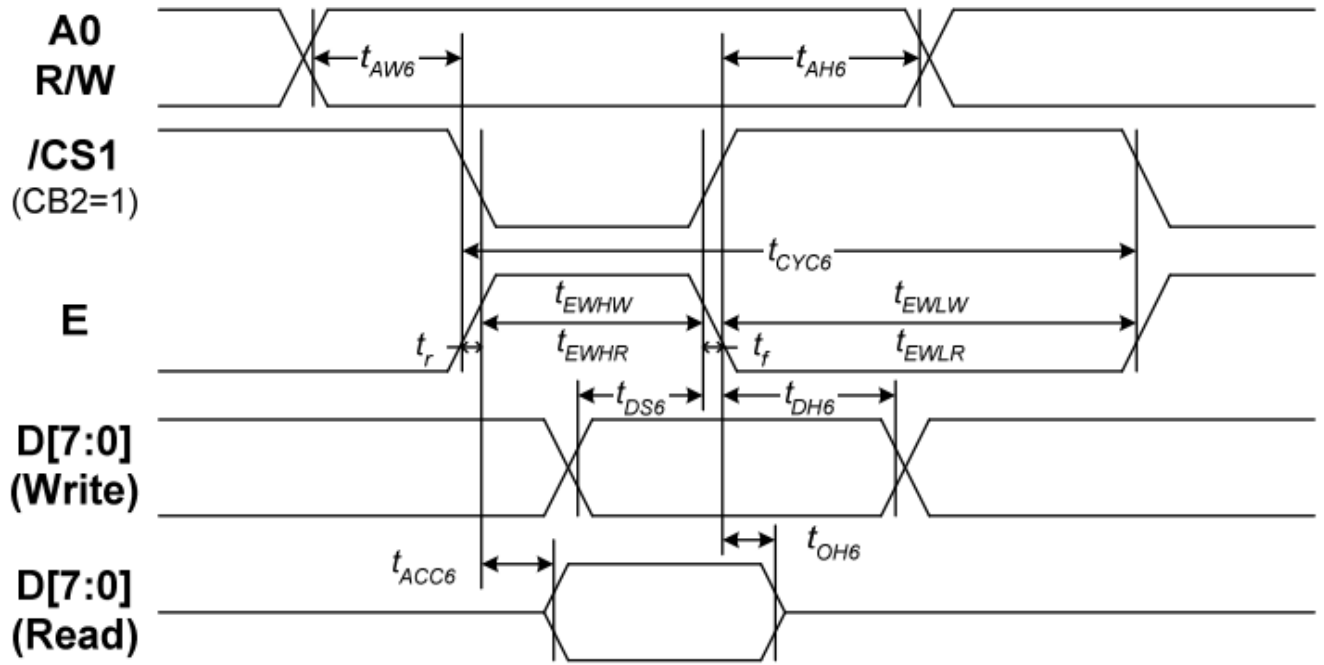
System Bus Read/Write Characteristics 1 (For the 8080 Series MPU)



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

| 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 | — | |
| Write L pulse width | /WR | t_{CCLW} | | 80 | — | |
| Write H pulse width | | t_{CCHW} | | 80 | — | |
| Read L pulse width | /RD | t_{CCLR} | | 140 | — | |
| Read H pulse width | | 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} | $C_L = 100$ pF | — | 70 | |
| Read Output disable time | | t_{OH8} | $C_L = 100$ pF | 5 | 50 | |

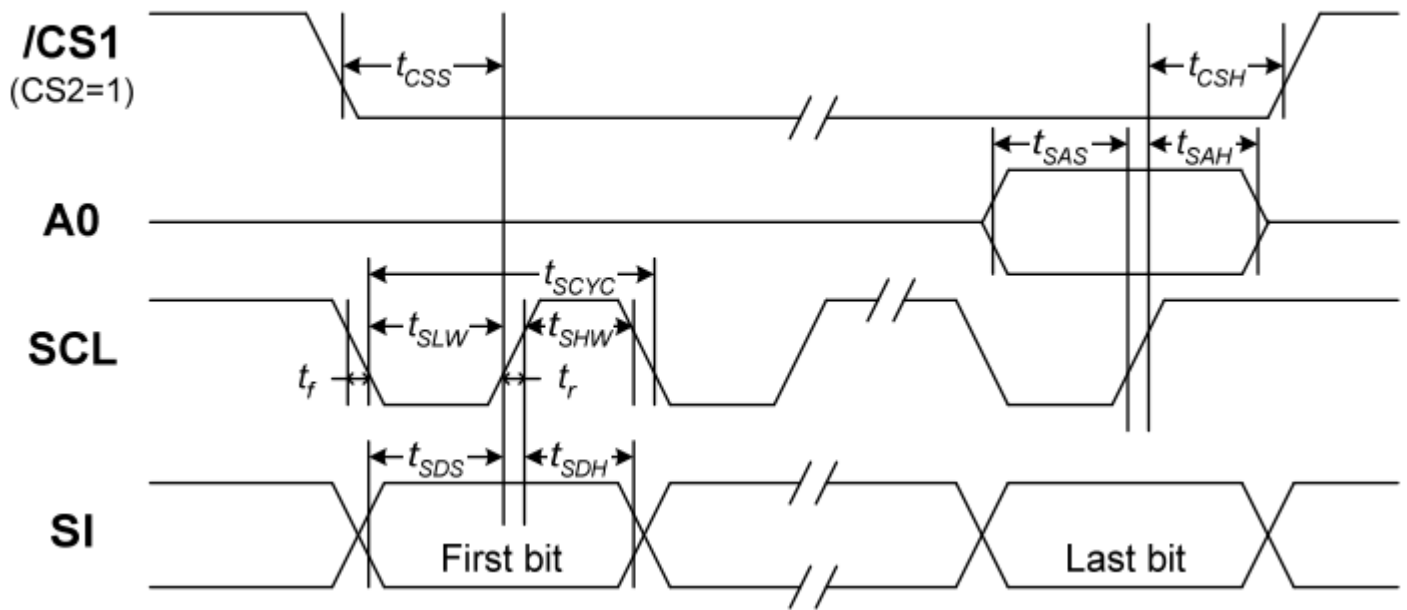
System Bus Read/Write Characteristics 2 (For the 6800 Series MPU)



($V_{DD} = 3.3V$, $T_a = -30$ 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 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

Warranty Information and Terms & Conditions

http://www.newhavendisplay.com/index.php?main_page=terms