

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 Temperature, 6:00 Optimal View |
| #-M- | Mounting Holes |
| | RoHS Compliant |

Newhaven Display International, Inc.

2661 Galvin Court

Elgin IL, 60124

Ph: 847-844-8795

Fax: 847-844-8796

www.newhavendisplay.com

nhtech@newhavendisplay.com

nhsales@newhavendisplay.com

Document Revision History

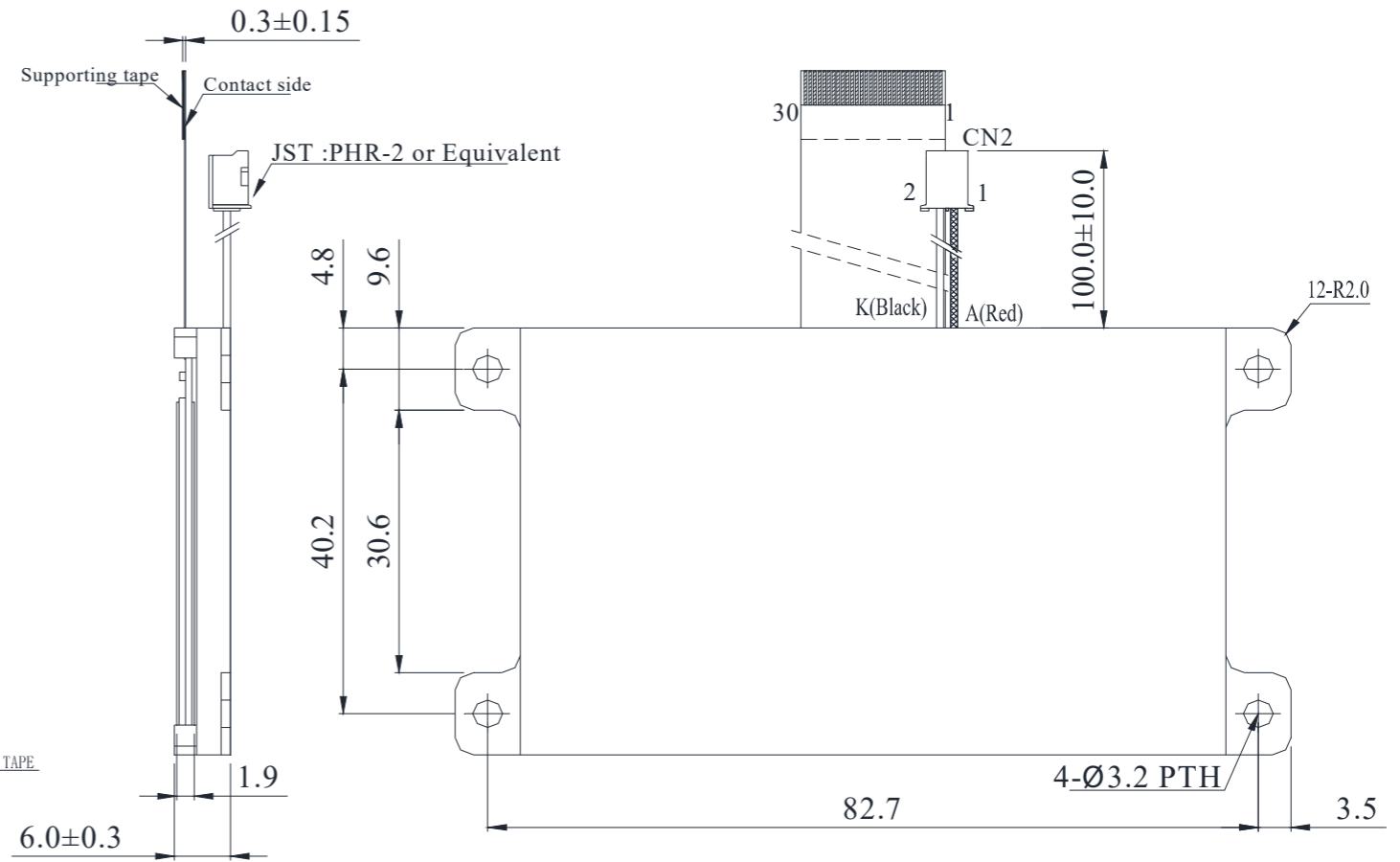
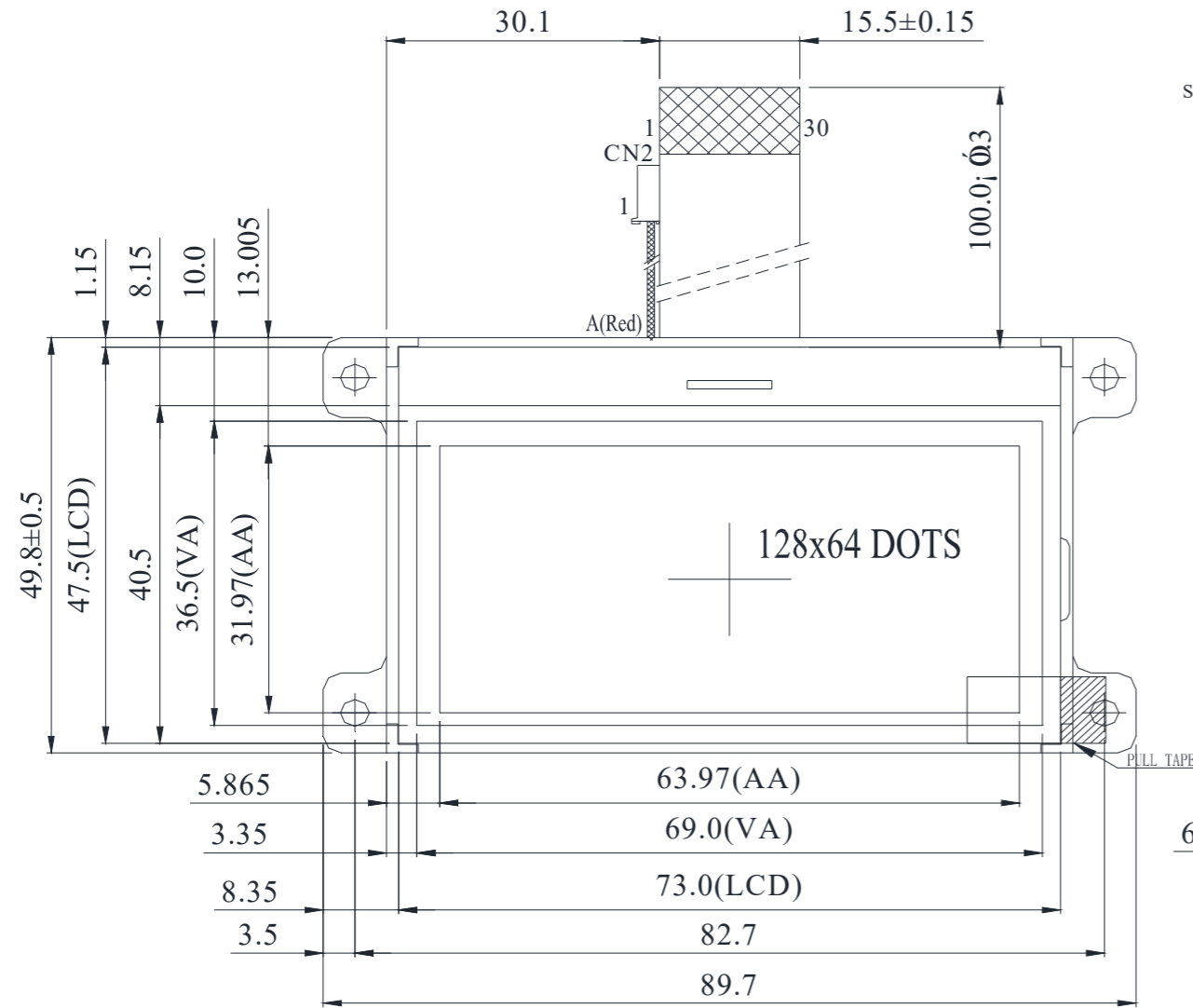
| Revision | Date | Description | Changed by |
|----------|---------|--|------------|
| 0 | 9/1/08 | Initial Release | - |
| 1 | 2/26/10 | User guide reformat | MC |
| 2 | 3/9/10 | Block diagram updated | BE |
| 3 | 5/4/10 | Block diagram and pin description | MP |
| 4 | 5/5/10 | Backlight Connectors updated | BE |
| 5 | 5/14/10 | Pin description update | MP |
| 6 | 5/2/11 | Example initialization code updated | AK |
| 7 | 5/13/11 | Block diagram updated | AK |
| 8 | 5/19/11 | Block diagram & Pin description updated | AK |
| 9 | 1/10/12 | Pin description & Controller link updated | AK |
| 10 | 6/15/12 | Timing characteristics updated | AK |
| 11 | 4/4/13 | Backlight mating connector, LCD voltage levels updated | AK |
| 12 | 4/15/13 | Optical characteristics updated | AK |
| 13 | 3/16/15 | Pin description updated | RM |
| 14 | 3/21/17 | Electrical & Optical Characteristics Updated | SB |
| 15 | 4/22/20 | Initialization Code Updated | TM |
| 16 | 7/16/20 | Updated 2D Mechanical Drawing format, Contrast Voltage Range, Contrast Ratio & Quality Information | AS |

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

| SYMBOL | REVISION | DATE |
|--------|----------|------|
| | | |
| | | |



| PIN NO. | SYMBOL | PIN NO. | SYMBOL | PIN NO. | SYMBOL |
|---------|----------|---------|-----------------|---------|--------|
| 1 | CS1B | 11 | D5 | 21 | CAP2N |
| 2 | /RES | 12 | D6 | 22 | V4 |
| 3 | A0 | 13 | D7 | 23 | V3 |
| 4 | /WR(R/W) | 14 | VDD | 24 | V2 |
| 5 | /RD(E) | 15 | V _{SS} | 25 | V1 |
| 6 | D0 | 16 | VOUT | 26 | V0 |
| 7 | D1 | 17 | CAP3P | 27 | VR |
| 8 | D2 | 18 | CAP1N | 28 | C86 |
| 9 | D3 | 19 | CAP1P | 29 | P/S |
| 10 | D4 | 20 | CAP2P | 30 | NC |

- Notes:**
1. Driver: 1/65 Duty, 1/9 Bias
 2. Display Mode: STN Positive / Gray / Transflective
 3. Optimal View: 6:00
 4. Voltage: 3.0V VDD, 9.5V VLCD
 5. Backlight: White LED
 6. Driver IC: ST7565P

| | | | |
|---|--|---|--|
| STANDARD TOLERANCE: (UNLESS OTHERWISE SPECIFIED) | | | |
| LINEAR: ±0.3mm | | | |
| UNLESS OTHERWISE SPECIFIED: - DIMENSIONS ARE IN MILLIMETERS - THIRD ANGLE PROJECTION | | DRAWING/PART NUMBER: NHD-12864WO-B1TGH#-M | |
| DO NOT SCALE DRAWING | | REVISION: 1.0 SIZE: A3 SCALE: NS | |
| THIS DRAWING IS SOLELY THE PROPERTY OF NEWHAVEN DISPLAY INTERNATIONAL, INC. THE INFORMATION IT CONTAINS IS NOT TO BE DISCLOSED, REPRODUCED OR COPIED IN WHOLE OR PART WITHOUT WRITTEN APPROVAL FROM NEWHAVEN DISPLAY. | | SHEET 1 OF 1 | |

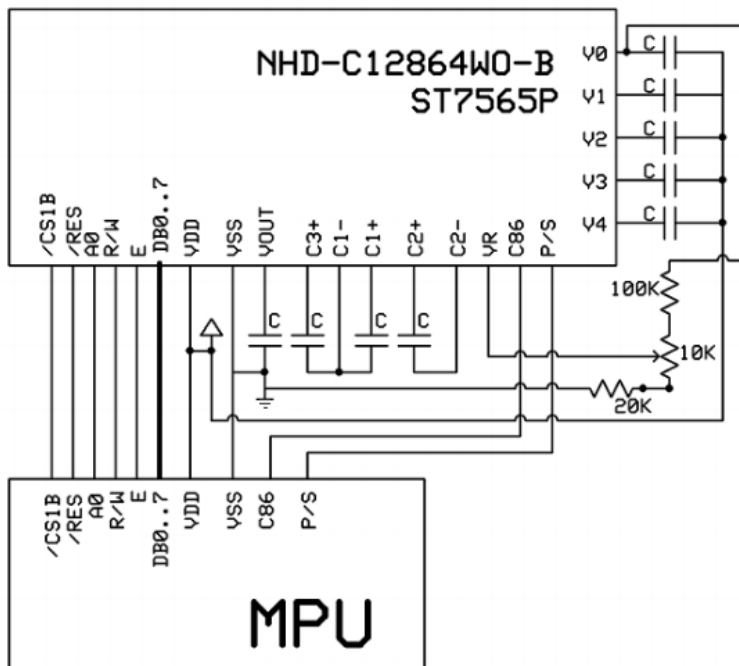
Pin Description and Wiring Diagram

| 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 | 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 |
| 6-13 | 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 | V _{DD} | Power Supply | Supply Voltage for Logic (+3.3V) |
| 15 | V _{SS} | Power Supply | Ground |
| 16 | V _{OUT} | Power Supply | 1-4.7 μ F cap to VSS |
| 17 | CAP3P | Power Supply | 1-4.7 μ F cap to CAP1N (pin-18) |
| 18 | CAP1N | Power Supply | 1-4.7 μ F cap to CAP3P (pin-17) and CAP1P (pin-19) |
| 19 | CAP1P | Power Supply | 1-4.7 μ F cap to CAP1N (pin-18) |
| 20 | CAP2P | Power Supply | 1-4.7 μ F cap to CAP2N (pin-21) |
| 21 | CAP2N | Power Supply | 1-4.7 μ F cap to CAP2P (pin-20) |
| 22-26 | V ₄ ~V ₀ | Power Supply | 0.1-4.7 μ F cap to V _{DD} or V _{SS} |
| 27 | V _R | Adj. Power Supply | Wiper of 10k Ω 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 | T _{OP} | Absolute Max | -20 | - | +70 | °C |
| Storage Temperature Range | T _{ST} | Absolute Max | -30 | - | +80 | °C |
| Supply Voltage | V _{DD} | - | 2.7 | 3.0 | 3.3 | V |
| Supply Current | I _{DD} | V _{DD} = 3.0V T _{OP} = 25°C | 0.1 | 0.6 | 2.0 | mA |
| Supply for LCD (contrast) | V _{LCD} | | 9.2 | 9.5 | 9.7 | V |
| "H" Level input | V _{IH} | - | 0.8 * V _{DD} | - | V _{DD} | V |
| "L" Level input | V _{IL} | - | V _{SS} | - | 0.2 * V _{DD} | V |
| "H" Level output | V _{OH} | - | 0.8 * V _{DD} | - | V _{DD} | V |
| "L" Level output | V _{OL} | - | V _{SS} | - | 0.2 * V _{DD} | V |
| LED Backlight voltage | V _{LED} | - | 3.4 | 3.5 | 3.6 | V |
| LED Backlight current | I _{LED} | V _{LED} = 3.5V | 20 | 64 | 80 | mA |

Optical Characteristics

| Item | Symbol | Condition | Min. | Typ. | Max. | Unit |
|------------------------|--------|------------------------|------|------|------|------|
| Optimal Viewing Angles | Top | CR ≥ 2 | - | 20 | - | ° |
| | Bottom | | - | 40 | - | ° |
| | Left | | - | 30 | - | ° |
| | Right | | - | 30 | - | ° |
| Contrast Ratio | CR | - | - | 3 | - | - |
| Response Time | Rise | T _{OP} = 25°C | - | 200 | 300 | ms |
| | Fall | | - | 250 | 350 | ms |

Controller Information

Built-in ST7565P controller

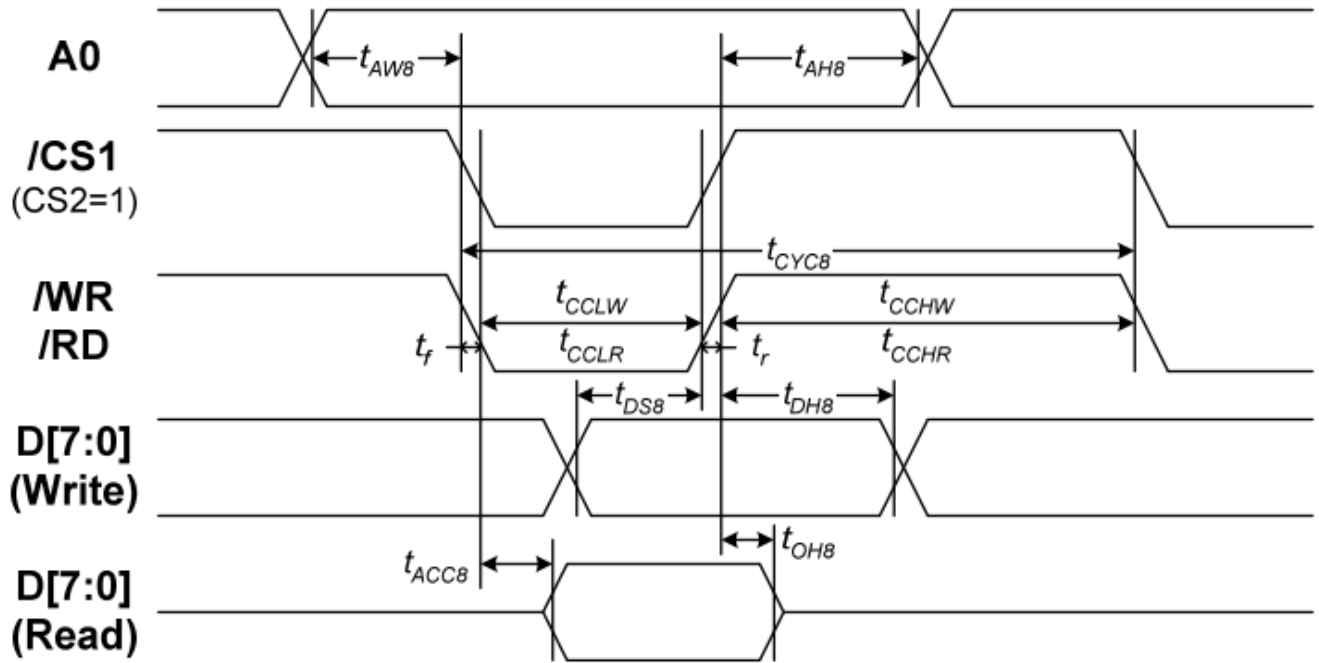
Please download specification at http://www.newhavendisplay.com/app_notes/ST7565P.pdf

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 | 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 | 0 | Clear read/modify/write |
| (14) Reset | 0 | 1 | 0 | 1 | 1 | 1 | 0 | 0 | 0 | 1 | 0 | 0 | Internal reset |
| (15) Common output mode select | 0 | 1 | 0 | 1 | 1 | 0 | 0 | 0 | * | * | * | * | 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 Electronic volume register set | 0 | 1 | 0 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | Set the V ₀ output voltage electronic volume register |
| (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 | 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

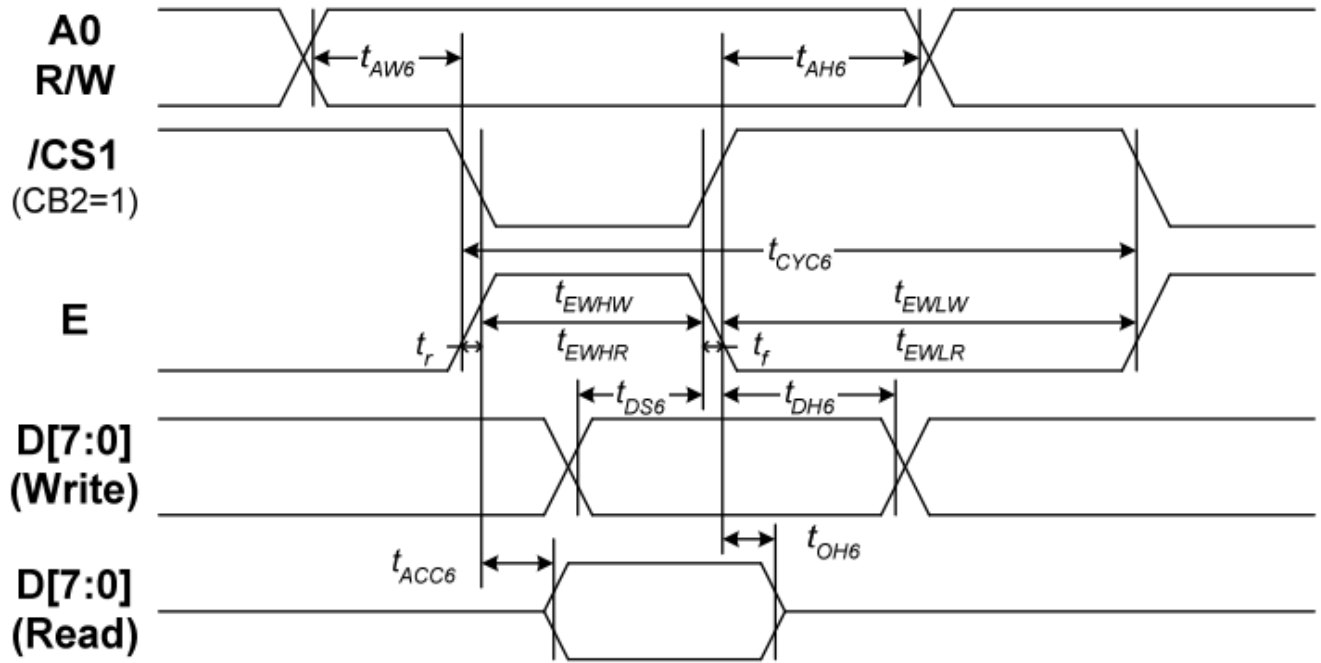
System Bus Read/Write Characteristics 1 (For the 8080 Series MPU)



(V_{DD} = 3.3V, T_a = -30 to 85°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} | CL = 100 pF | — | 70 | |
| Read Output disable time | | t _{OH8} | CL = 100 pF | 5 | 50 | |

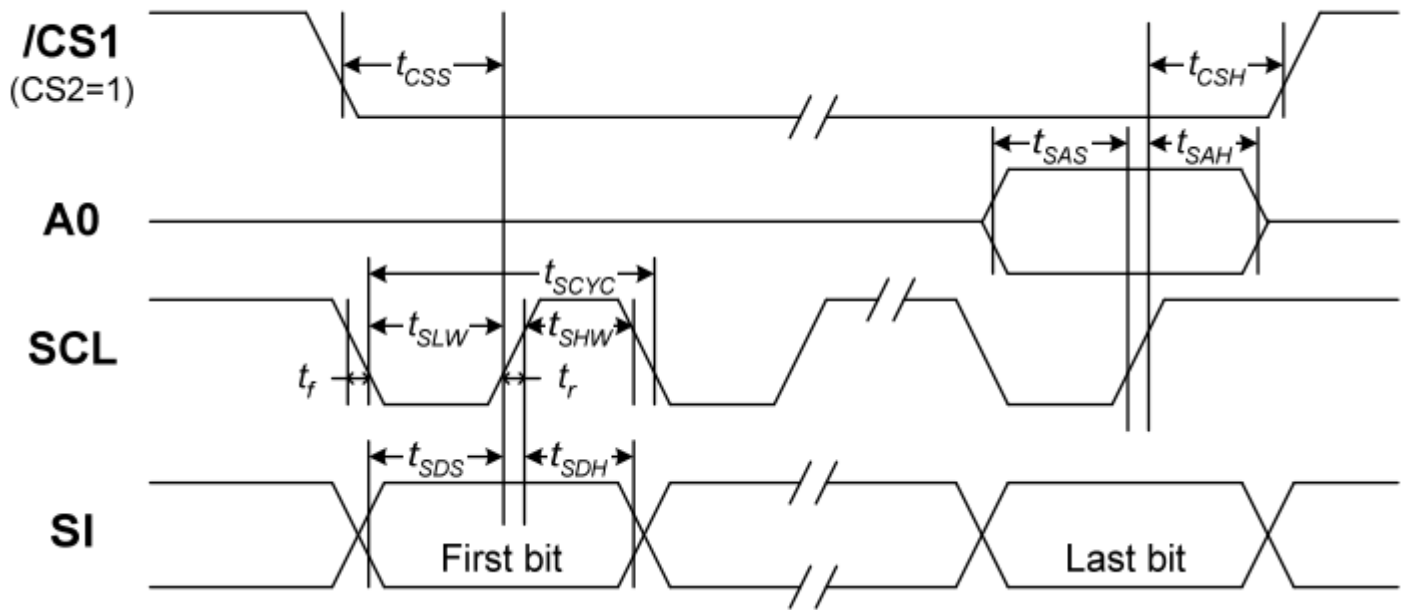
System Bus Read/Write Characteristics 2 (For the 6800 Series MPU)



($V_{DD} = 3.3V$, $T_a = -30$ 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_{EWLW} | | 80 | — | |
| Enable H pulse width (WRITE) | | t_{EHWLW} | | 80 | — | |
| Enable L pulse width (READ) | | t_{EWLR} | | 80 | — | |
| Enable H pulse width (READ) | | t_{EWHR} | | 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()
{
    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);   // LCD drive voltage bias ratio. 1/9 bias
    comm_out(0xA0);   // ADC segment driver direction (A0=Normal)
    comm_out(0xC0);   // COM output scan direction (C0= Normal)
    comm_out(0x40);   // Display Start Line address
    comm_out(0x25);   // Resistor ratio set
    comm_out(0x10);   // Column address upper 4 bits + 0x10
    comm_out(0x00);   // Column address lower 4 bits + 0x00
    comm_out(0x81);   // Electronic Volume Command (set contrast) Double Byte: 1 of 2
    comm_out(0x25);   // Electronic Volume value (contrast value) Double Byte: 2 of 2 //was 0x19
    comm_out(0x2F);   // Power Control Set
    comm_out(0xAF);   // Display 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 , 1.5mm amplitude. 60 sec in each of 3 directions X,Y,Z For 15 minutes | 3 |
| Static electricity test | Endurance test applying electric static discharge. | Air: ±800V 150pF/330Ω, 5 Times | |
| | | Contact: ±600V 150pF/330Ω, 5 Times | |

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