# NHD-2.7-12864WDY3-M

## Graphic OLED Display Module

| | |
|---|---|
| NHD- | Newhaven Display |
| 2.7- | 2.7” Diagonal Size |
| 12864- | 128 x 64 Pixel Resolution |
| WD- | Model |
| Y- | Emitting Color: Yellow |
| 3- | +3.3V Power Supply |
| M- | Molex (52271-2079) Connector Interface |


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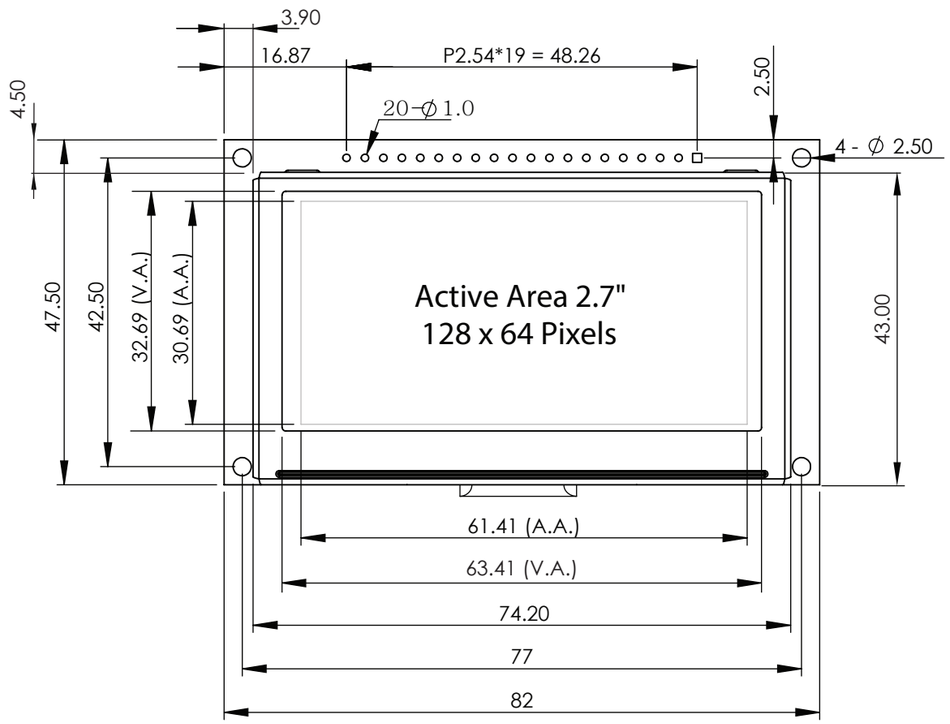
## Document Revision History

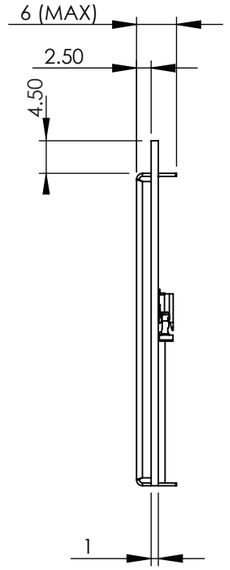
| Revision | Date | Description | Changed by |
|---|---|---|---|
| - | 6/2/2017 | Initial Release | ML |
| 1 | 7/25/2017 | Update Storage Temperature range | ML |
| 2 | 3/31/20 | Brightness Updated, Updated Interface Information | SB |
| 3 | 5/12/20 | Included Additional Dimensions on Mechanical Drawing | AS |

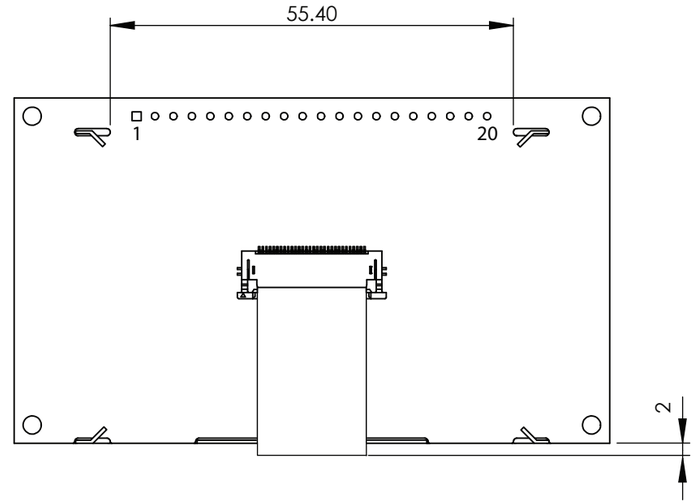
## Functions and Features

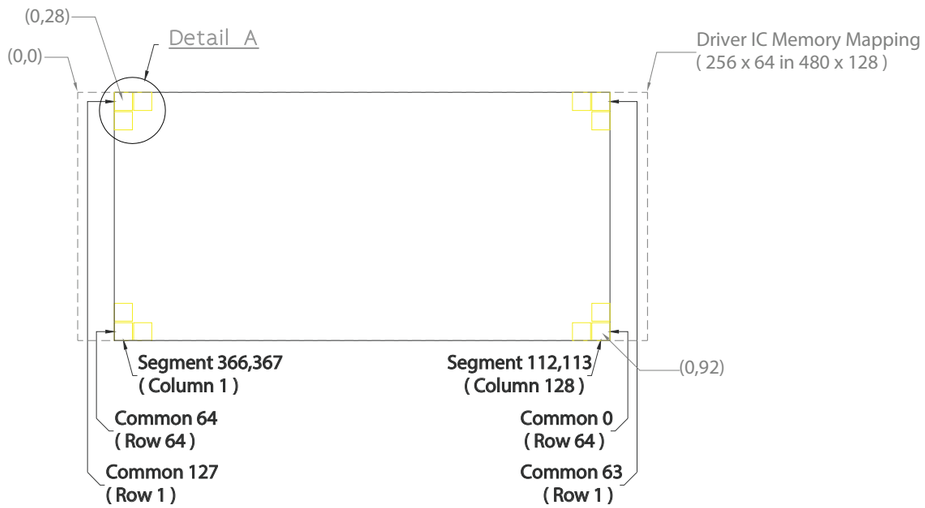
- **128 x 64 pixel resolution**
- **Built-in SSD1322 controller**
- **Parallel or Serial MPU interface**
- **Single, low voltage power supply**
- **Power options via on-board jumpers**
- **RoHS compliant**

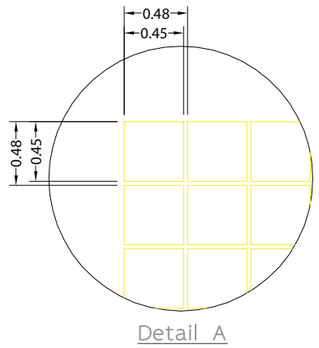
| SYMBOL | REVISION | DATE |
|---|---|---|
| | | |
| | | |




Notes:
1. Display Color: Yellow
2. Interface: 8-bit 68XX/80XX Parallel, 3-/4-wire SPI
3. Controller: SSD1322

| | | |
|---|---|---|
| STANDARD TOLERANCE: (UNLESS OTHERWISE SPECIFIED) LINEAR: ±0.3mm | NEWHAVEN DISPLAY INTERNATIONAL | |
| | DRAWING/PART NUMBER: NHD-2.7-12864WDY3-M | REVISION: 1.0 |
| UNLESS OTHERWISE SPECIFIED: - DIMENSIONS ARE IN MILLIMETERS - THIRD ANGLE PROJECTION | DRAWN BY: H. Aloum / APPROVED BY: A. Khan | SIZE: A3 |
| | DRAWN DATE: 05/06/20 / APPROVED DATE: 05/06/20 | SCALE: NS |
| | DO NOT SCALE DRAWING | SHEET 1 OF 1 |

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# Interface Description

**Parallel Interface:**

| Pin No. | Symbol | External Connection | Function Description |
|---|---|---|---|
| 1 | $V_{SS}$ | Power Supply | Ground |
| 2 | $V_{DD}$ | Power Supply | Supply Voltage for OLED module |
| 3 | N.C. (BC_$V_{DD}$) | - | No Connect by default. Can be configured to provide independent supply voltage (2.8V – 12V DC) for boost converter. (refer to On-Board Jumper Options section below) |
| 4 | D/C | MPU | Data/Command select signal, D/C=0: Command; D/C=1: Data |
| 5 | R/W or /WR | MPU | **6800-interface:**<br>Read/Write select signal, R/W=1: Read, R/W=0: Write<br>**8080-interface:**<br>Active LOW Write signal |
| 6 | E or /RD | MPU | **6800-interface:**<br>Operation Enable signal Active High<br>**8080-interface:**<br>Active LOW Read signal |
| 7-14 | DB0 – DB7 | MPU | 8-bit bi-directional Data Bus |
| 15 | N.C. (VCC) | - | No Connect by default. Can be configured for external VCC (+15V).<br>(refer to On-Board Jumper Options table below) |
| 16 | /RES | MPU | Active LOW Reset signal |
| 17 | /CS | MPU | Active LOW Chip Select signal |
| 18 | /SHDN (N.C.) | MPU | Active LOW Shutdown control pin for boost converter (pulled HIGH via on-board 15kΩ resistor)<br>Can be made a No Connect by removing resistor R1. |
| 19 | BS1 | MPU | MPU Interface select signal |
| 20 | BS0 | MPU | MPU Interface select signal |

**Serial Interface:**

| Pin No. | Symbol | External Connection | Function Description |
|---|---|---|---|
| 1 | $V_{SS}$ | Power Supply | Ground |
| 2 | $V_{DD}$ | Power Supply | Supply Voltage for OLED module |
| 3 | N.C. (BC_$V_{DD}$) | - | No Connect by default. Can be configured to provide independent supply voltage (2.8V – 12V DC) for boost converter. (refer to On-Board Jumper Options table below) |
| 4 | D/C | MPU | Data/Command select signal, D/C=0: Command; D/C=1: Data<br>(tie LOW for 3-wire Serial Interface) |
| 5-6 | VSS | Power Supply | Ground |
| 7 | SCLK | MPU | Serial Clock signal |
| 8 | SDIN | MPU | Serial Data Input signal |
| 9 | N.C. | - | No Connect |
| 10-14 | VSS | Power Supply | Ground |
| 15 | N.C. (VCC) | - | No Connect by default. Can be configured for external VCC (+15V).<br>(refer to On-Board Jumper Options section below) |
| 16 | /RES | MPU | Active LOW Reset signal |
| 17 | /CS | MPU | Active LOW Chip Select signal |
| 18 | /SHDN (N.C.) | MPU | Active LOW Shutdown control pin for boost converter (pulled HIGH via on-board 15kΩ resistor)<br>Can be made a No Connect by removing resistor R1. |
| 19 | BS1 | MPU | MPU Interface select signal |
| 20 | BS0 | MPU | MPU Interface select signal |

# Interface Selection

**MPU Interface Pin Selections**

| Pin Name | 6800 Parallel 8-bit interface | 8080 Parallel 8-bit interface | 3-wire Serial Interface | 4-wire Serial Interface |
|---|---|---|---|---|
| BS1 | 1 | 1 | 0 | 0 |
| BS0 | 1 | 0 | 1 | 0 |

**MPU Interface Pin Assignment Summery**

| Bus Interface | Data/Command Interface | | | | | | | | Control Signals | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | D7 | D6 | D5 | D4 | D3 | D2 | D1 | D0 | E | R/W | /CS | D/C | /RES |
| 8-bit 6800 | D[7:0] | | | | | | | | E | R/W | /CS | D/C | /RES |
| 8-bit 8080 | D[7:0] | | | | | | | | /RD | /WR | /CS | D/C | /RES |
| 3-wire SPI | Tie LOW | | | | | NC | SDIN | SCLK | Tie LOW | | /CS | Tie LOW | /RES |
| 4-wire SPI | Tie LOW | | | | | NC | SDIN | SCLK | Tie LOW | | /CS | D/C | /RES |

# On-Board Jumper Options

**Default Jumper Setting**

| R4 | R5 | R7 | Description |
|---|---|---|---|
| **Close** | Open | Open | **(default)** OLED controller and boost converter + OLED panel are powered from VDD (pin #2). This allows the full module to be powered by a single low-voltage supply. |

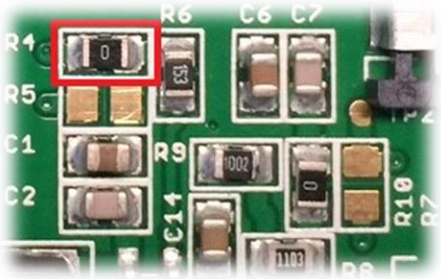
**Jumper Option #1 - Independent Supply Voltage for Boost Converter** (BC_VDD)

| R4 | R5 | R7 | Description |
|---|---|---|---|
| Open | **Close** | Open | Boost converter + OLED panel are powered from BC_VDD (pin #3). OLED controller is still powered from VDD (pin #2). This allows for increased efficiency through the boost converter, by allowing a supply voltage up to +12V at its input, BC_VDD (pin #3). |

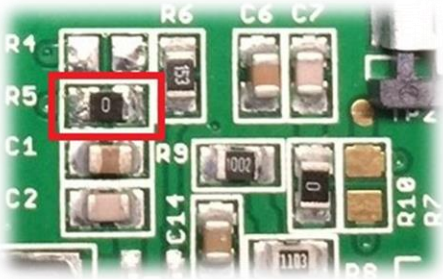
**Jumper Option #2 – External Supply Voltage for OLED Panel** (VCC)

| R4 | R5 | R7 | Description |
|---|---|---|---|
| Open | Open | **Close** | OLED panel is powered from VCC (pin #15) – boost converter is not used.<br>OLED controller is still powered from VDD (pin #2). This allows for maximum module efficiency, and drastically reduced total current consumption. |

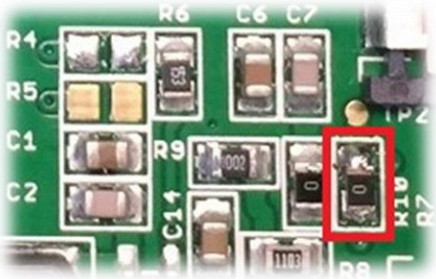
*Default Jumper Setting*




*Jumper Option #1*




*Jumper Option #2*




**For detailed electrical information on each jumper option, please see the Electrical Characteristics table below.**

# Electrical Characteristics

*Values for Current shown below are based on the recommended initialization provided on page 12.*

| Item | Symbol | Condition | Min. | Typ. | Max. | Unit |
|---|---|---|---|---|---|---|
| Operating Temperature Range | $T_{OP}$ | Absolute Max | -40 | - | +85 | °C |
| Storage Temperature Range | $T_{ST}$ | Absolute Max | -40 | - | +85 | °C |
| **Default Jumper Setting** | | | | | | |
| **Supply Voltage for Module** | **$V_{DD}$** | **-** | **2.8** | **3.3** | **3.5** | **V** |
| **Supply Current for Module** | **$I_{DD}$** | **VDD=3.3V, 50% ON** | **-** | **200** | **220** | **mA** |
| | | **VDD=3.3V, 100% ON** | **-** | **330** | **360** | **mA** |
| Jumper Option #1 | | | | | | |
| Supply Voltage for Module | $V_{DD}$ | - | 2.8 | 3.3 | 3.5 | V |
| Supply Voltage for Boost Converter | BC_$V_{DD}$ | - | 2.8 | - | 12 | V |
| Supply Current for Module | $I_{DD}$ | VDD=3.3V | - | 180 | 295 | µA |
| Supply Current for Boost Converter | $I_{DD_BC}$ | BC_VDD=5.0V, 50% ON | - | 125 | 140 | mA |
| | | BC_VDD=5.0V, 100% ON | - | 190 | 205 | mA |
| | | BC_VDD=12.0V, 50% ON | - | 50 | 60 | mA |
| | | BC_VDD=12.0V, 100% ON | - | 70 | 80 | mA |
| Jumper Option #2 | | | | | | |
| Supply Voltage for Module | $V_{DD}$ | - | 2.8 | 3.3 | 3.5 | V |
| Supply Voltage for OLED Panel | $V_{CC}$ | - | 14.5 | 15 | 15.5 | V |
| Supply Current for Module | $I_{DD}$ | $V_{DD}$=3.3V | - | 180 | 300 | µA |
| Supply Current for OLED Panel | $I_{CC}$ | $V_{CC}$=15V, 50% ON | - | 35 | 40 | mA |
| | | $V_{CC}$=15V, 100% ON | - | 50 | 60 | mA |
| | | | | | | |
| Sleep Mode Current | $I_{DD_SLEEP}$ | - | - | 25 | 120 | µA |
| "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 | $V_{OH}$ | - | 0.9 * $V_{DD}$ | - | $V_{DD}$ | V |
| "L" Level output | $V_{OL}$ | - | $V_{SS}$ | - | 0.1 * $V_{DD}$ | V |

**Note:** The electrical characteristics shown above for Jumper Option #1 and Jumper Option #2 apply only when the on-board jumpers are configured accordingly. By default, only Default Jumper Setting supply voltage and current (in bold) need to be considered. For details, see On-Board Jumper Options section on previous page.

# Optical Characteristics

*Values for Brightness shown below are based on the recommended initialization provided on page 12.*

| Item | | Symbol | Condition | Min. | Typ. | Max. | Unit |
|---|---|---|---|---|---|---|---|
| Optimal Viewing Angles | Top | φY+ | - | - | 85 | - | º |
| | Bottom | φY- | | - | 85 | - | º |
| | Left | θX- | | - | 85 | - | º |
| | Right | θX+ | | - | 85 | - | º |
| Contrast Ratio | | $C_r$ | - | >10,000:1 | - | - | - |
| Response Time | Rise | $T_R$ | - | - | 15 | - | ns |
| | Fall | $T_F$ | - | - | 15 | - | ns |
| Brightness | | $L_V$ | 50% Checkerboard | 60 | 80 | - | cd/m$^2$ |
| Lifetime | | - | $T_{OP}$ =25°C, $L_V$=100cd/m$^2$ | 60,000 | - | - | hrs |
| | | - | $T_{OP}$ =25°C, $L_V$=80cd/m$^2$ | 100,000 | - | - | hrs |

**Note**: Lifetime at typical temperature is based on accelerated high-temperature operation. Lifetime is tested at average 50% pixels on and is rated as Hours until **Half-Brightness**. To extend the life of the display, lower values may be used for the contrast setting registers – see below table of commands for details.

# Controller Information

Built-in SSD1322 controller.

For details, view full datasheet at http://www.newhavendisplay.com/app_notes/SSD1322.pdf

# Table of Commands

| Instruction | Code | | | | | | | | | | Description | RESET value |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | D/C | HEX | DB7 | DB6 | DB5 | DB4 | DB3 | DB2 | DB1 | DB0 | | |
| Enable Grayscale Table | 0 | **00** | **0** | **0** | **0** | **0** | **0** | **0** | **0** | **0** | Enable the Grayscale table settings. (see command 0xB8) | |
| Set Column Address | 0<br>1<br>1 | **15**<br>**A[6:0]**<br>**B[6:0]** | **0**<br>*<br>* | **0**<br>**A6**<br>**B6** | **0**<br>**A5**<br>**B5** | **1**<br>**A4**<br>**B4** | **0**<br>**A3**<br>**B3** | **1**<br>**A2**<br>**B2** | **0**<br>**A1**<br>**B1** | **1**<br>**A0**<br>**B0** | Set column start and end address<br>A[6:0]: Column start address. Range: 0-119d<br>B[6:0]: Column end address. Range: 0-119d | <br>0<br>119d |
| Write RAM Command | 0 | **5C** | **0** | **1** | **0** | **1** | **1** | **1** | **0** | **0** | Enable MCU to write Data into RAM | |
| Read RAM Command | 0 | **5D** | **0** | **1** | **0** | **1** | **1** | **1** | **0** | **1** | Enable MCU to read Data from RAM | |
| Set Row Address | 0<br>1<br>1 | **75**<br>**A[6:0]**<br>**B[6:0]** | **0**<br>*<br>* | **1**<br>**A6**<br>**B6** | **1**<br>**A5**<br>**B5** | **1**<br>**A4**<br>**B4** | **0**<br>**A3**<br>**B3** | **1**<br>**A2**<br>**B2** | **0**<br>**A1**<br>**B1** | **1**<br>**A0**<br>**B0** | Set row start and end address<br>A[6:0]: Row start address. Range: 0-127d<br>B[6:0]: Row end address. Range: 0-127d | <br>0<br>127d |
| Set Re-map | 0<br>1<br>1 | **A0**<br>**A[5:0]**<br>**B[4]** | **1**<br>**0**<br>* | **0**<br>**0**<br>* | **1**<br>**A5**<br>**0** | **0**<br>**A4**<br>**B4** | **0**<br>**0**<br>**0** | **0**<br>**A2**<br>**0** | **0**<br>**A1**<br>**0** | **0**<br>**A0**<br>**1** | A[0] = 0; Horizontal Address Increment<br>A[0] = 1; Vertical Address Increment<br>A[1] = 0; Disable Column Address remap<br>A[1] = 1; Enable Column Address remap<br>A[2] = 0; Disable Nibble remap<br>A[2] = 1; Enable Nibble remap<br>A[4] = 0; Scan from COM0 to COM[N-1]<br>A[4] = 1; Scan from COM[N-1] to COM0<br>A[5] = 0; Disable COM split Odd/Even<br>A[5] = 1; Enable COM split Odd/Even<br>B[4] = 0; Disable Dual COM mode<br>B[4] = 1; Enable Dual COM mode<br>Note: A[5] must be 0 if B[4] is 1. | 0<br><br>0<br><br>0<br><br>0<br><br>0<br><br>0 |
| Set Display Start Line | 0<br>1 | **A1**<br>**A[6:0]** | **1**<br>* | **0**<br>**A6** | **1**<br>**A5** | **0**<br>**A4** | **0**<br>**A3** | **0**<br>**A2** | **0**<br>**A1** | **1**<br>**A0** | Set display RAM display start line register from 0-127. | 0 |
| Set Display Offset | 0<br>1 | **A2**<br>**A[6:0]** | **1**<br>* | **0**<br>**A6** | **1**<br>**A5** | **0**<br>**A4** | **0**<br>**A3** | **0**<br>**A2** | **1**<br>**A1** | **0**<br>**A0** | Set vertical shift by COM from 0~127. | 0 |
| Display Mode | 0 | **A4~A7** | **1** | **0** | **1** | **0** | **0** | **X2** | **X1** | **X0** | 0xA4 = Entire display OFF<br>0xA5 = Entire display ON, all pixels Grayscale level 15<br>0xA6 = Normal display<br>0xA7 = Inverse display | 0xA6 |
| Enable Partial Display | 0<br>1<br>1 | **A8**<br>**A[6:0]**<br>**B[6:0]** | **1**<br>**0**<br>**0** | **0**<br>**A6**<br>**B6** | **1**<br>**A5**<br>**B5** | **0**<br>**A4**<br>**B4** | **1**<br>**A3**<br>**B3** | **0**<br>**A2**<br>**B2** | **0**<br>**A1**<br>**B1** | **0**<br>**A0**<br>**B0** | Turns ON partial mode.<br>A[6:0] = Address of start row<br>B[6:0] = Address of end row (B[6:0] > A[6:0]) | |
| Exit Partial Display | 0 | **A9** | **1** | **0** | **1** | **0** | **1** | **0** | **0** | **1** | Exit Partial Display mode | |
| Function Selection | 0<br>1 | **AB**<br>**A[0]** | **1**<br>**0** | **0**<br>**0** | **1**<br>**0** | **0**<br>**0** | **1**<br>**0** | **0**<br>**0** | **1**<br>**0** | **1**<br>**A0** | A[0] = 0; External VDD<br>A[0] = 1; Internal VDD regulator | <br>1 |

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Set Sleep Mode ON/OFF | 0 | **AE~AF** | **1** | **0** | **1** | **0** | **1** | **1** | **1** | **X0** | 0xAE = Sleep Mode ON (display OFF)<br>0xAF = Sleep Mode OFF (display ON) | |
| Set Phase Length | 0<br>1 | **B1**<br>**A[7:0]** | **1**<br>**A7** | **0**<br>**A6** | **1**<br>**A5** | **1**<br>**A4** | **0**<br>**A3** | **0**<br>**A2** | **0**<br>**A1** | **1**<br>**A0** | A[3:0] = P1. Phase 1 period of 5-31 DCLK clocks<br>A[7:4] = P2. Phase 2 period of 3-15 DCLK clocks | 9<br>7 |
| Set Display Clock Divide Ratio / Oscillator Frequency | 0<br>1 | **B3**<br>**A[7:0]** | **1**<br>**A7** | **0**<br>**A6** | **1**<br>**A5** | **1**<br>**A4** | **0**<br>**A3** | **0**<br>**A2** | **1**<br>**A1** | **1**<br>**A0** | A[3:0] = 0000; divide by 1<br>A[3:0] = 0001; divide by 2<br>A[3:0] = 0010; divide by 4<br>A[3:0] = 0011; divide by 8<br>A[3:0] = 0100; divide by 16<br>A[3:0] = 0101; divide by 32<br>A[3:0] = 0110; divide by 64<br>A[3:0] = 0111; divide by 128<br>A[3:0] = 1000; divide by 256<br>A[3:0] = 1001; divide by 512<br>A[3:0] = 1010; divide by 1024<br>A[3:0] >= 1011; invalid<br>A[7:4] = Set the Oscillator Frequency. Frequency increases with the value of A[7:4]. Range 0000b~1111b. | 0<br><br><br><br><br><br><br><br><br><br><br>1100b |
| VSL / Display Enhancement | 0<br>1<br>1 | **B4**<br>**A[1:0]**<br>**B[7:3]** | **1**<br>**1**<br>**B7** | **0**<br>**0**<br>**B6** | **1**<br>**1**<br>**B5** | **1**<br>**0**<br>**B4** | **0**<br>**0**<br>**B3** | **1**<br>**0**<br>**1** | **0**<br>**A1**<br>**0** | **0**<br>**A0**<br>**1** | A[1:0] = 00b; Enable external VSL<br>A[1:0] = 10b; Internal VSL<br>B[7:3] = 11111b; Enhanced low GS display quality<br>B[7:3] = 10110b; Normal | <br>10b<br><br>10110b |
| Set GPIO | 0<br>1 | **B5**<br>**A[3:0]** | **1**<br>* | **0**<br>* | **1**<br>* | **1**<br>* | **0**<br>**A3** | **1**<br>**A2** | **0**<br>**A1** | **1**<br>**A0** | A[1:0] = 00; GPIO0 input disabled<br>A[1:0] = 01; GPIO0 input enabled<br>A[1:0] = 10; GPIO0 output LOW<br>A[1:0] = 11; GPIO0 output HIGH<br>A[3:2] = 00; GPIO1 input disabled<br>A[3:2] = 01; GPIO1 input enabled<br>A[3:2] = 10; GPIO1 output LOW<br>A[3:2] = 11; GPIO1 output HIGH | <br><br>10b<br><br><br><br>10b |
| Set Second Pre-charge Period | 0<br>1 | **B6**<br>**A[3:0]** | **1**<br>* | **0**<br>* | **1**<br>* | **1**<br>* | **0**<br>**A3** | **1**<br>**A2** | **1**<br>**A1** | **0**<br>**A0** | Sets the second precharge period<br>A[3:0] = DCLKs | 1000b |
| Set Grayscale Table | 0<br>1<br>1<br>1<br>1<br>1<br>1 | **B8**<br>**A1[7:0]**<br>**A2[7:0]**<br>.<br>.<br>.<br>**A14[7:0]**<br>**A15[7:0]** | **1**<br>**$A1_7$**<br>**$A2_7$**<br>.<br>.<br>.<br>**$A14_7$**<br>**$A15_7$** | **0**<br>**$A1_6$**<br>**$A2_6$**<br>.<br>.<br>.<br>**$A14_6$**<br>**$A15_6$** | **1**<br>**$A1_5$**<br>**$A2_5$**<br>.<br>.<br>.<br>**$A14_5$**<br>**$A15_5$** | **1**<br>**$A1_4$**<br>**$A2_4$**<br>.<br>.<br>.<br>**$A14_4$**<br>**$A15_4$** | **1**<br>**$A1_3$**<br>**$A2_3$**<br>.<br>.<br>.<br>**$A14_3$**<br>**$A15_3$** | **0**<br>**$A1_2$**<br>**$A2_2$**<br>.<br>.<br>.<br>**$A14_2$**<br>**$A15_2$** | **0**<br>**$A1_1$**<br>**$A2_1$**<br>.<br>.<br>.<br>**$A14_1$**<br>**$A15_1$** | **0**<br>**$A1_0$**<br>**$A2_0$**<br>.<br>.<br>.<br>**$A14_0$**<br>**$A15_0$** | Sets the gray scale pulse width in units of DCLK. Range 0-180d.<br>A1[7:0] = Gamma Setting for GS1<br>A2[7:0] = Gamma Setting for GS2<br>.<br>.<br>.<br>A14[7:0] = Gamma Setting for GS14<br>A15[7:0] = Gamma Setting for GS15<br><br>Note: 0 < GS1 < GS2 < GS3 … < GS14 < GS15<br>The setting must be followed by command 0x00. | |

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Select Default Linear Gray Scale Table | 0 | **B9** | **1** | **0** | **1** | **1** | **1** | **0** | **0** | **1** | Sets Linear Grayscale table<br>GS0 pulse width = 0<br>GS0 pulse width = 0<br>GS0 pulse width = 8<br>GS0 pulse width = 16<br>.<br>.<br>.<br>GS0 pulse width = 104<br>GS0 pulse width = 112 | |
| Set Pre-charge Voltage | 0<br>1 | **BB**<br>**A[4:0]** | **1**<br>* | **0**<br>* | **1**<br>* | **1**<br>**A4** | **1**<br>**A3** | **0**<br>**A2** | **1**<br>**A1** | **1**<br>**A0** | Set precharge voltage level.<br>A[4:0] = 0x00; 0.20*VCC<br>.<br>.<br>A[4:0] = 0x3E; 0.60*VCC | 0x17 |
| Set VCOMH Voltage | 0<br>1 | **BE**<br>**A[3:0]** | **1**<br>* | **0**<br>* | **1**<br>* | **1**<br>* | **1**<br>**A3** | **1**<br>**A2** | **1**<br>**A1** | **0**<br>**A0** | Sets the VCOMH voltage level<br>A[3:0] = 0x00; 0.72*VCC<br>.<br>.<br>A[3:0] = 0x04; 0.8*VCC<br>.<br>.<br>A[3:0] = 0x07; 0.86*VCC | 0x04 |
| Set Contrast Control | 0<br>1 | **C1**<br>**A[7:0]** | **1**<br>**A7** | **1**<br>**A6** | **0**<br>**A5** | **0**<br>**A4** | **0**<br>**A3** | **0**<br>**A2** | **0**<br>**A1** | **1**<br>**A0** | Double byte command to select 1 out of 256 contrast steps.<br>Contrast increases as the value increases. | 0x7F |
| Master Contrast Control | 0<br>1 | **C7**<br>**A[3:0]** | **1**<br>* | **1**<br>* | **0**<br>* | **0**<br>* | **0**<br>**A3** | **1**<br>**A2** | **1**<br>**A1** | **1**<br>**A0** | A[3:0] = 0x00; Reduce output for all colors to 1/16<br>A[3:0] = 0x01; Reduce output for all colors to 2/16<br>.<br>.<br>A[3:0] = 0x0E; Reduce output for all colors to 15/16<br>A[3:0] = 0x0F; no change | 0x0f |
| Set Multiplex Ratio | 0<br>1 | **CA**<br>**A[6:0]** | **1**<br>* | **1**<br>**A6** | **0**<br>**A5** | **0**<br>**A4** | **1**<br>**A3** | **0**<br>**A2** | **1**<br>**A1** | **0**<br>**A0** | Set MUX ratio to N+1 MUX<br>N=A[6:0]; from 16MUX to 128MUX (0 to 14 are invalid) | 127d |
| Set Command Lock | 0<br>1 | **FD**<br>**A[2]** | **1**<br>**0** | **1**<br>**0** | **1**<br>**0** | **1**<br>**1** | **1**<br>**0** | **1**<br>**A2** | **0**<br>**1** | **1**<br>**0** | A[2] = 0; Unlock OLED to enable commands<br>A[2] = 1; Lock OLED from entering commands | 0x12 |

**For detailed instruction information, view full SSD1322 datasheet here (pages 32-47):**
http://www.newhavendisplay.com/app_notes/SSD1322.pdf

# MPU Interface

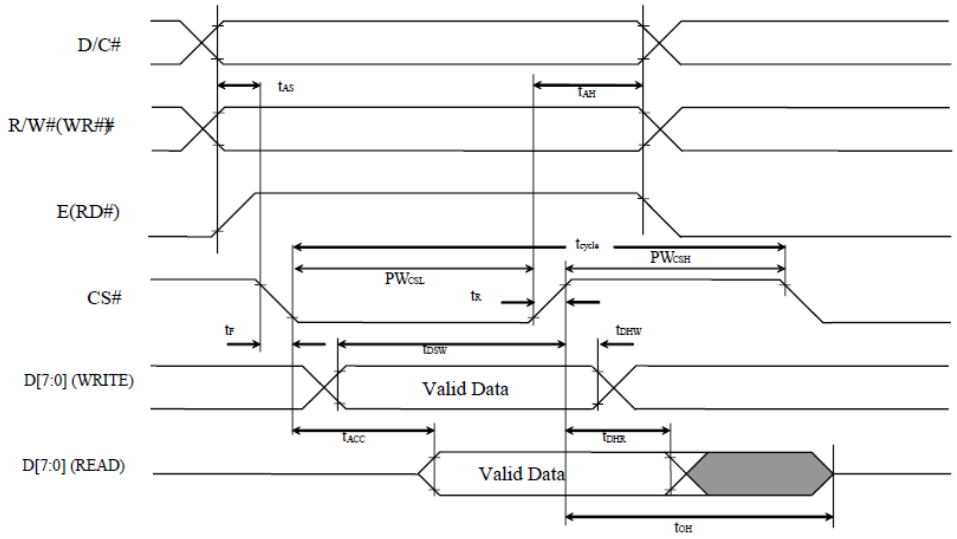
**6800-MPU Parallel Interface**

The parallel interface consists of 8 bi-directional data pins, R/W, D/C, E, and /CS.
A LOW on R/W indicates write operation, and HIGH on R/W indicates read operation.
A LOW on D/C indicates "Command" read or write, and HIGH on D/C indicates "Data" read or write.
The E input serves as data latch signal, while /CS is LOW. Data is latched at the falling edge of E signal.

| Function | E | R/W | /CS | D/C |
|---|---|---|---|---|
| Write Command | ↓ | 0 | 0 | 0 |
| Read Status | ↓ | 1 | 0 | 0 |
| Write Data | ↓ | 0 | 0 | 1 |
| Read Data | ↓ | 1 | 0 | 1 |

($V_{DD}$ - $V_{SS}$ = 2.4 to 2.6V, $V_{DDIO}$=1.6V, $V_{CI}$ = 3.3V, $T_A$ = 25°C)

| Symbol | Parameter | Min | Typ | Max | Unit |
|---|---|---|---|---|---|
| $t_{cycle}$ | Clock Cycle Time | 300 | - | - | ns |
| $t_{AS}$ | Address Setup Time | 10 | - | - | ns |
| $t_{AH}$ | Address Hold Time | 0 | - | - | ns |
| $t_{DSW}$ | Write Data Setup Time | 40 | - | - | ns |
| $t_{DHW}$ | Write Data Hold Time | 7 | - | - | ns |
| $t_{DHR}$ | Read Data Hold Time | 20 | - | - | ns |
| $t_{OH}$ | Output Disable Time | - | - | 70 | ns |
| $t_{ACC}$ | Access Time | - | - | 140 | ns |
| $PW_{CSL}$ | Chip Select Low Pulse Width (read)<br>Chip Select Low Pulse Width (write) | 120<br>60 | - | - | ns |
| $PW_{CSH}$ | Chip Select High Pulse Width (read)<br>Chip Select High Pulse Width (write) | 60<br>60 | - | - | ns |
| $t_R$ | Rise Time | - | - | 15 | ns |
| $t_F$ | Fall Time | - | - | 15 | ns |



**8080-MPU Parallel Interface**

The parallel interface consists of 8 bi-directional data pins, /RD, /WR, D/C, and /CS.

A LOW on D/C indicates “Command” read or write, and HIGH on D/C indicates “Data” read or write.

A rising edge of /RS input serves as a data read latch signal while /CS is LOW.

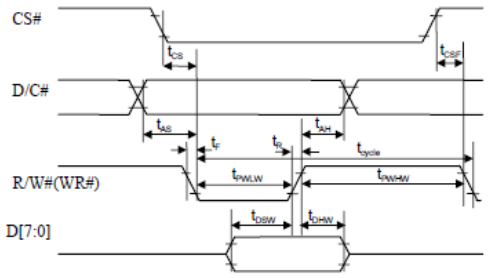
A rising edge of /WR input serves as a data/command write latch signal while /CS is LOW.

| Function | /RD | /WR | /CS | D/C |
|---|---|---|---|---|
| Write Command | 1 | ↑ | 0 | 0 |
| Read Status | ↑ | 1 | 0 | 0 |
| Write Data | 1 | ↑ | 0 | 1 |
| Read Data | ↑ | 1 | 0 | 1 |

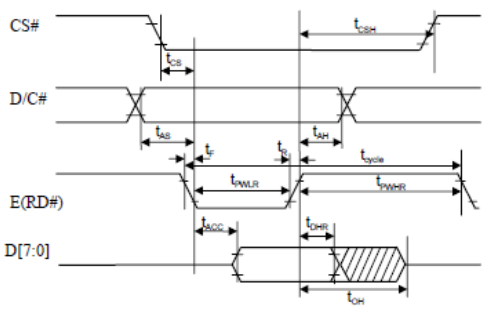
($V_{DD}$ - $V_{SS}$ = 2.4 to 2.6V, $V_{DDIO}$=1.6V, $V_{CI}$ = 3.3V, $T_A$ = 25°C)

| Symbol | Parameter | Min | Typ | Max | Unit |
|---|---|---|---|---|---|
| $t_{cycle}$ | Clock Cycle Time | 300 | - | - | ns |
| $t_{AS}$ | Address Setup Time | 10 | - | - | ns |
| $t_{AH}$ | Address Hold Time | 0 | - | - | ns |
| $t_{DSW}$ | Write Data Setup Time | 40 | - | - | ns |
| $t_{DHW}$ | Write Data Hold Time | 7 | - | - | ns |
| $t_{DHR}$ | Read Data Hold Time | 20 | - | - | ns |
| $t_{OH}$ | Output Disable Time | - | - | 70 | ns |
| $t_{ACC}$ | Access Time | - | - | 140 | ns |
| $t_{PWLR}$ | Read Low Time | 150 | - | - | ns |
| $t_{PWLW}$ | Write Low Time | 60 | - | - | ns |
| $t_{PWHR}$ | Read High Time | 60 | - | - | ns |
| $t_{PWHW}$ | Write High Time | 60 | - | - | ns |
| $t_R$ | Rise Time | - | - | 15 | ns |
| $t_F$ | Fall Time | - | - | 15 | ns |
| $t_{CS}$ | Chip select setup time | 0 | - | - | ns |
| $t_{CSH}$ | Chip select hold time to read signal | 0 | - | - | ns |
| $t_{CSF}$ | Chip select hold time | 20 | - | - | ns |

Write cycle




Read cycle



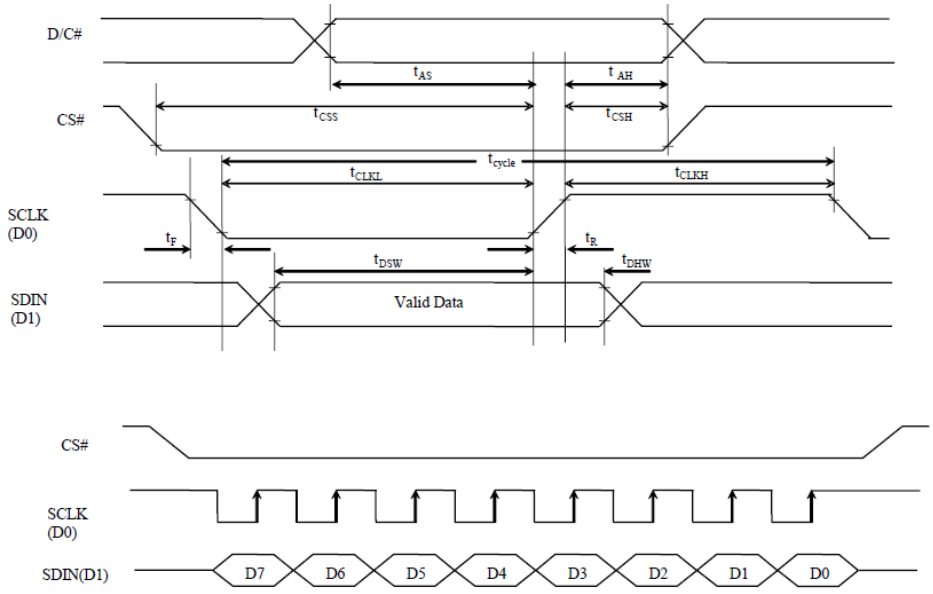
**Serial Interface (4-wire)**

The 4-wire serial interface consists of Serial Clock (SCLK), Serial Data (SDIN), Data/Command (D/C), and Chip Select (/CS). D0 acts as SCLK and D1 acts as SDIN. D2 must be left as a No Connect
D3~D7, E, and R/W should be connected to GND.

| Function | /RD | /WR | /CS | D/C | D0 |
|---|---|---|---|---|---|
| Write Command | Tie LOW | Tie LOW | 0 | 0 | ↑ |
| Write Data | Tie LOW | Tie LOW | 0 | 1 | ↑ |

($V_{DD}$ - $V_{SS}$ = 2.4 to 2.6V, $V_{DDIO}$=1.6V, $V_{CI}$ = 3.3V, $T_A$ = 25°C)

| Symbol | Parameter | Min | Typ | Max | Unit |
|---|---|---|---|---|---|
| $t_{cycle}$ | Clock Cycle Time | 100 | - | - | ns |
| $t_{AS}$ | Address Setup Time | 15 | - | - | ns |
| $t_{AH}$ | Address Hold Time | 15 | - | - | ns |
| $t_{CSS}$ | Chip Select Setup Time | 20 | - | - | ns |
| $t_{CSH}$ | Chip Select Hold Time | 10 | - | - | ns |
| $t_{DSW}$ | Write Data Setup Time | 15 | - | - | ns |
| $t_{DHW}$ | Write Data Hold Time | 15 | - | - | ns |
| $t_{CLKL}$ | Clock Low Time | 20 | - | - | ns |
| $t_{CLKH}$ | Clock High Time | 20 | - | - | ns |
| $t_R$ | Rise Time | - | - | 15 | ns |
| $t_F$ | Fall Time | - | - | 15 | ns |







SDIN is shifted into an 8-bit shift register on every rising edge of SCLK in the order of D7, D6,…D0.
D/C is sampled on every eighth clock and the data byte in the shift register is written to the GDDRAM or command register in the same clock.
Note: Read functionality is not available in serial mode.

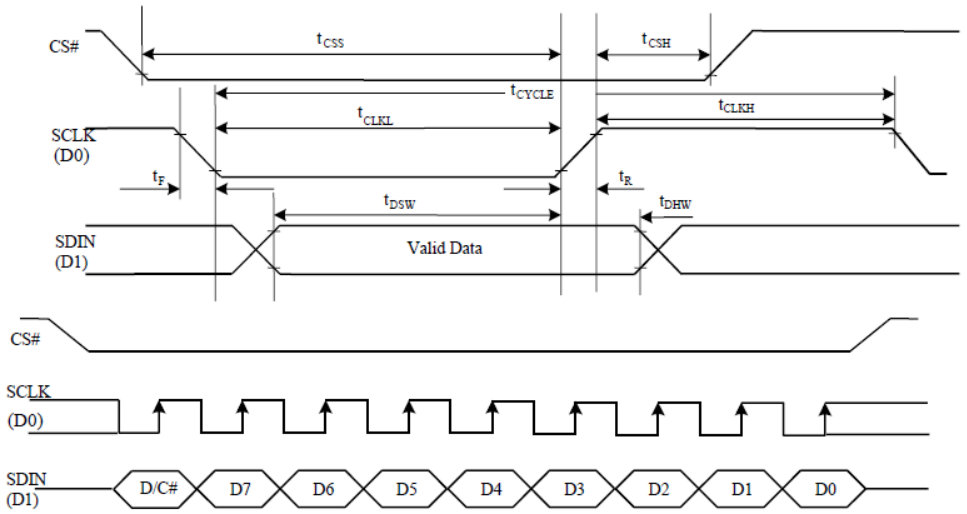
**Serial Interface (3-wire)**

The 3-wire serial interface consists of Serial Clock (SCLK), Serial Data In (SDIN), and Chip Select (/CS).
D0 acts as SCLK and D1 acts as SDIN. D2 must be left as a No Connect.
D3~D7, E, R/W, and D/C should be connected to Ground.

| Function | /RD | /WR | /CS | D/C | D0 |
|---|---|---|---|---|---|
| Write Command | Tie LOW | Tie LOW | 0 | Tie LOW | ↑ |
| Write Data | Tie LOW | Tie LOW | 0 | Tie LOW | ↑ |

($V_{DD}$ - $V_{SS}$ = 2.4 to 2.6V, $V_{DDIO}$=1.6V, $V_{CI}$ = 3.3V, $T_A$ = 25°C)

| Symbol | Parameter | Min | Typ | Max | Unit |
|---|---|---|---|---|---|
| $t_{cycle}$ | Clock Cycle Time | 100 | - | - | ns |
| $t_{CSS}$ | Chip Select Setup Time | 20 | - | - | ns |
| $t_{CSH}$ | Chip Select Hold Time | 10 | - | - | ns |
| $t_{DSW}$ | Write Data Setup Time | 15 | - | - | ns |
| $t_{DHW}$ | Write Data Hold Time | 15 | - | - | ns |
| $t_{CLKL}$ | Clock Low Time | 20 | - | - | ns |
| $t_{CLKH}$ | Clock High Time | 20 | - | - | ns |
| $t_R$ | Rise Time | - | - | 15 | ns |
| $t_F$ | Fall Time | - | - | 15 | ns |




SDIN is shifted into an 9-bit shift register on every rising edge of SCLK in the order of D/C, D7, D6,…D0.
D/C (first bit of the sequential data) will determine if the following data byte is written to the Display Data RAM (D/C = 1) or the command register (D/C = 0).
Note: Read functionality is not available in serial mode.

**For detailed timing information for each interface mode, view full SSD1322 datasheet here (pages 50-54):**
http://www.newhavendisplay.com/app_notes/SSD1322.pdf

## Recommended Initialization

```
void NHD12864WDY3_Init(void){
        digitalWrite(RES, LOW);          //pull /RES (pin #16) low
        delayUS(200);                    //keep /RES low for minimum 200µs
        digitalWrite(RES, HIGH);         //pull /RES high
        delayUS(200);                    //wait minimum 200µs before sending commands
        writeCommand(0xAE);              //display OFF
        writeCommand(0xB3);              //set CLK div. & OSC freq.
        writeData(0x91);
        writeCommand(0xCA);              //set MUX ratio
        writeData(0x3F);
        writeCommand(0xA2);              //set offset
        writeData(0x00);
        writeCommand(0xAB);              //function selection
        writeData(0x01);
        writeCommand(0xA0);              //set re-map
        writeData(0x16);
        writeData(0x11);
        writeCommand(0xC7);              //master contrast current
        writeData(0x0F);
        writeCommand(0xC1);              //set contrast current
        writeData(0x9F);
        writeCommand(0xB1);              //set phase length
        writeData(0xF2);
        writeCommand(0xBB);              //set pre-charge voltage
        writeData(0x1F);
        writeCommand(0xB4);              //set VSL
        writeData(0xA0);
        writeData(0xFD);
        writeCommand(0xBE);              //set VCOMH
        writeData(0x04);
        writeCommand(0xA6);              //set display mode
        writeCommand(0xAF);              //display ON
}
```

# Example Software Routines

```
void setColumn(unsigned char xStart, unsigned char xEnd){
   writeCommand(0x15);       //set column (x-axis) start/end address
   writeData(xStart);        //column start; 28 is left-most column
   writeData(xEnd);          //column end; 91 is right-most column
}

void setRow(unsigned char yStart, unsigned char yEnd){
   writeCommand(0x75);       //set row (y-axis) start/end address
   writeData(yStart);        //row start; 0 is top row
   writeData(yEnd);          //row end; 63 is bottom row
}

void clearDisplay(void){
   unsigned int i;
   setColumn(28,91);         //set column (x-axis) start/end address
   setRow(0,63);             //set row (y-axis) start/end address
   writeRAM();               //single byte command (0x5C) to initiate pixel data write to GDDRAM;
   for(i=0;i<4096;i++){      // ((91-28)+1)*((63-0)+1)
    writeData(0x00);
    writeData(0x00);
   }
}

void write2Pixels(unsigned char xPos, unsigned char yPos, unsigned char pixel1, unsigned char pixel2){
   if(pixel1>=1) pixel1 = 0xFF;          //set 1st pixel value to ON
   else pixel1 = 0x00;                   //set 1st pixel value to OFF
   if(pixel2>=1) pixel2 = 0xFF;          //set 2nd pixel value to ON
   else pixel2 = 0x00;                   //set 2nd pixel value to OFF
   if(xPos>127) xPos = 127;              //boundary check (MIN xPos = 0, MAX xPos = 127)
   xPos = xPos/2;                        //account for GDDRAM address mapping
   xPos+=28;                             //account for GDDRAM address mapping
   if(yPos>63) yPos = 63;                //boundary check (MIN yPos = 0, MAX yPos = 63)
   setColumn(xPos,xPos);                 //set column (x-axis) start/end address
   setRow(yPos,yPos);                    //set row (y-axis) start/end address
   writeRAM();                           //single byte command (0x5C) to initiate pixel data write to GDDRAM;
   writeData(pixel1);                    //write 1st of 2 pixels to the display
   writeData(pixel2);                    //write 2nd of 2 pixels to the display
}

void displayArray12864(const unsigned char arr[]){          //display 128x64 monochrome bitmap, horizontal pixel arrangement, 8-pixels per byte
   unsigned int i, j;
   setColumn(28,91);                     //set column (x-axis) start/end address
   setRow(0,63);                         //set row (y-axis) start/end address
   writeRAM();                           //single byte command (0x5C) to initiate pixel data write to GDDRAM;
   for(i=0;i<1024;i++){                  //translate each byte/bit into pixel data
    for(j=0;j<8;j++){
     if(((arr[i]<<j)&0x80)==0x80){
      writeData(0xFF);
     }
     else{
      writeData(0x00);
     }
    }
   }
}
```

# Quality Information

| Test Item | Content of Test | Test Condition | Note |
|---|---|---|---|
| High Temperature storage | Test the endurance of the display at high storage temperature. | +85°C, 240hrs | 2 |
| Low Temperature storage | Test the endurance of the display at low storage temperature. | -40°C, 240hrs | 1,2 |
| High Temperature Operation | Test the endurance of the display by applying electric stress (voltage & current) at high temperature. | +85°C, 240hrs | 2 |
| Low Temperature Operation | Test the endurance of the display by applying electric stress (voltage & current) at low temperature. | -40°C, 240hrs | 1,2 |
| High Temperature / Humidity Operation | Test the endurance of the display by applying electric stress (voltage & current) at high temperature with high humidity. | +60°C, 90% RH, 240hrs | 1,2 |
| Thermal Shock resistance | Test the endurance of the display by applying electric stress (voltage & current) during a cycle of low and high temperatures. | -40°C, 30min -> +25°C, 5min -> +85°C, 30min = 1 cycle<br>100 cycles | |
| Vibration test | Test the endurance of the display by applying vibration to simulate transportation and use. | 10-22Hz, 15mm amplitude.<br>22-500Hz, 1.5G<br>30min in each of 3 directions<br>X,Y,Z | 3 |
| Atmospheric Pressure test | Test the endurance of the display by applying atmospheric pressure to simulate transportation by air. | 115mbar, 40hrs | 3 |
| Static electricity test | Test the endurance of the display by 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 2 hours of storage at 25°C, 0%RH.
**Note 3:** Test performed on product itself, not inside a container.
**Evaluation Criteria:**
1: Display is fully functional during operational tests and after all tests, at room temperature.
2: No observable defects.
3: Luminance >50% of initial value.
4: Current consumption within 50% of initial value

# Precautions for using OLEDs/LCDs/LCMs

See Precautions at www.newhavendisplay.com/specs/precautions.pdf

# Warranty Information

See Terms & Conditions at http://www.newhavendisplay.com/index.php?main_page=terms

# OCEAN CHIPS
## Океан Электроники
## Поставка электронных компонентов

Компания «Океан Электроники» предлагает заключение долгосрочных отношений при поставках импортных электронных компонентов на взаимовыгодных условиях!

Наши преимущества:

- Поставка оригинальных импортных электронных компонентов напрямую с производств Америки, Европы и Азии, а так же с крупнейших складов мира;
- Широкая линейка поставок активных и пассивных импортных электронных компонентов (более 30 млн. наименований);
- Поставка сложных, дефицитных, либо снятых с производства позиций;
- Оперативные сроки поставки под заказ (от 5 рабочих дней);
- Экспресс доставка в любую точку России;
- Помощь Конструкторского Отдела и консультации квалифицированных инженеров;
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- Поставка электронных компонентов под контролем ВП;
- Система менеджмента качества сертифицирована по Международному стандарту ISO 9001;
- При необходимости вся продукция военного и аэрокосмического назначения проходит испытания и сертификацию в лаборатории (по согласованию с заказчиком);
- Поставка специализированных компонентов военного и аэрокосмического уровня качества (Xilinx, Altera, Analog Devices, Intersil, Interpoint, Microsemi, Actel, Aeroflex, Peregrine, VPT, Syfer, Eurofarad, Texas Instruments, MS Kennedy, Miteq, Cobham, E2V, MA-COM, Hittite, Mini-Circuits, General Dynamics и др.);

Компания «Океан Электроники» является официальным дистрибьютором и эксклюзивным представителем в России одного из крупнейших производителей разъемов военного и аэрокосмического назначения «**JONHON**», а так же официальным дистрибьютором и эксклюзивным представителем в России производителя высокотехнологичных и надежных решений для передачи СВЧ сигналов «**FORSTAR**».

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