

Product Specification

NHD-2.8-25664UCB2

Graphic OLED Display Module

| | |
|---------------|---------------------------|
| NHD- | Newhaven Display |
| 2.8- | 2.8" Diagonal Size |
| 25664- | 256 x 64 Pixel Resolution |
| UC- | Model |
| B- | Emitting Color: Blue |
| 2- | 3V Power Supply |

Table of Contents

| | |
|--------------------------------------|----|
| Document Revision History..... | 2 |
| Mechanical Drawing | 3 |
| Pin Description | 4 |
| Wiring Diagrams | 5 |
| On-Board Jumper Options | 6 |
| Electrical Characteristics | 7 |
| Optical Characteristics | 7 |
| Controller Information..... | 8 |
| MPU Interface | 8 |
| Example Initialization Sequence..... | 9 |
| Quality Information | 10 |

Additional Resources

- **Support Forum:** <https://support.newhavendisplay.com/hc/en-us/community/topics>
- **GitHub:** <https://github.com/newhavendisplay>
- **Example Code:** <https://support.newhavendisplay.com/hc/en-us/categories/4409527834135-Example-Code/>
- **Knowledge Center:** https://www.newhavendisplay.com/knowledge_center.html
- **Quality Center:** https://www.newhavendisplay.com/quality_center.html
- **Precautions for using LCDs/LCMs:** <https://www.newhavendisplay.com/specs/precautions.pdf>
- **Warranty / Terms & Conditions:** <https://www.newhavendisplay.com/terms.html>

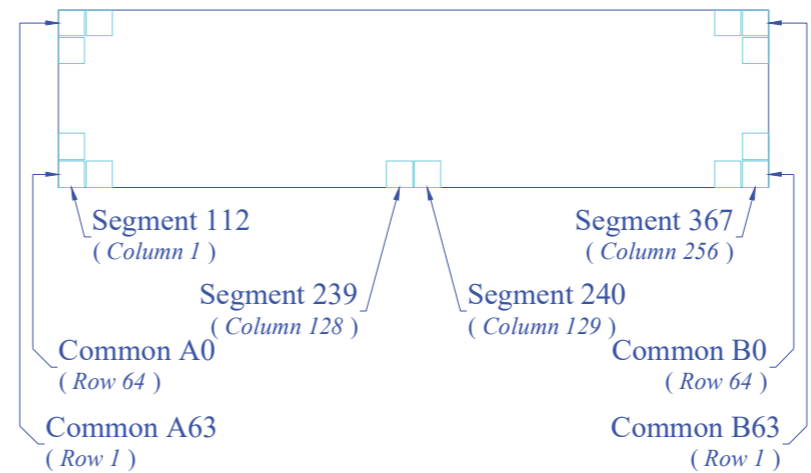
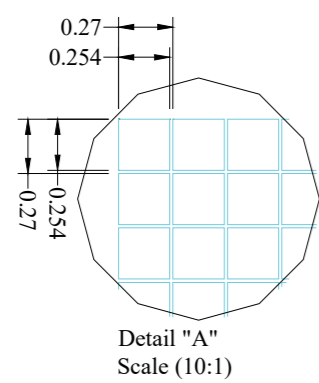
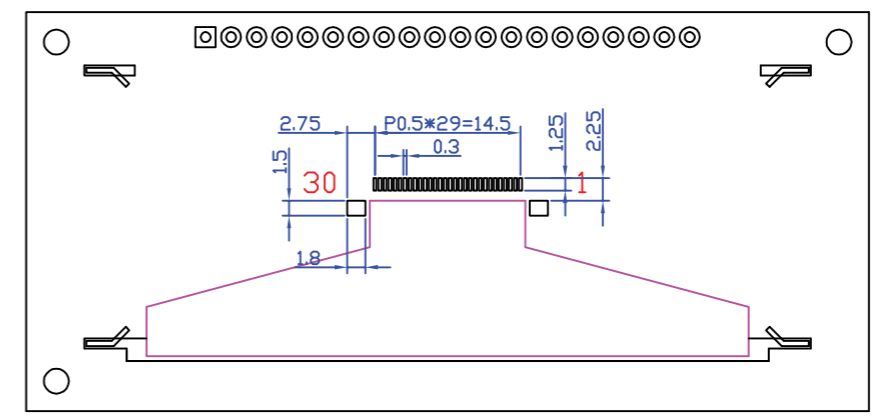
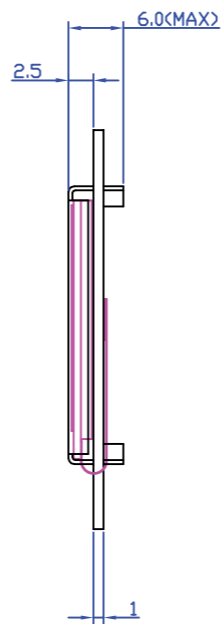
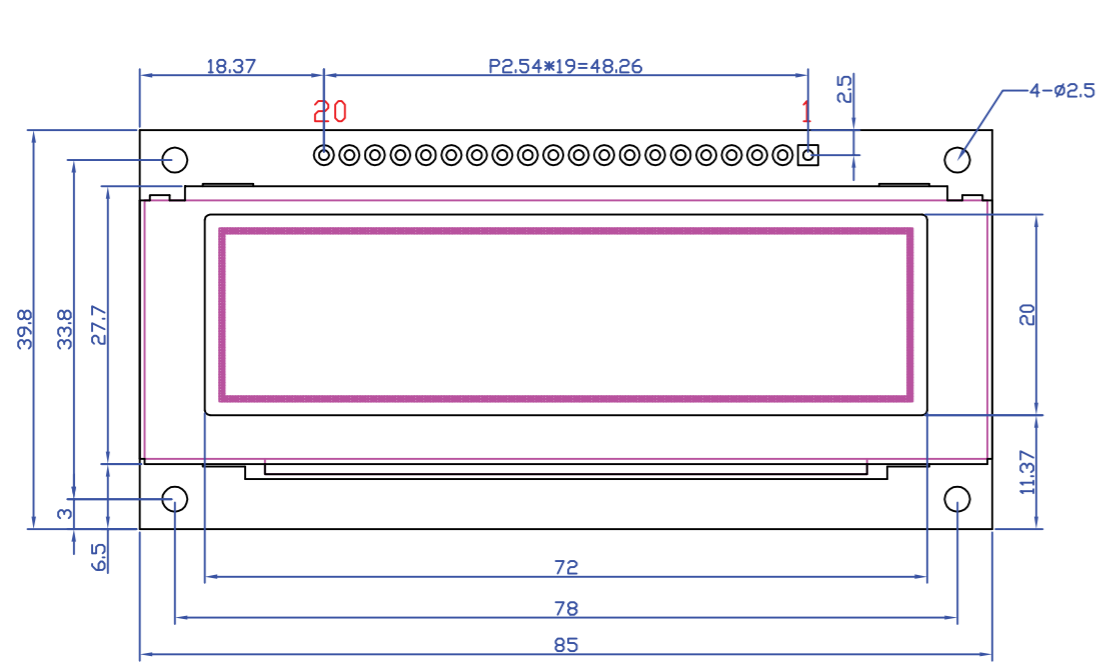


Document Revision History

| Revision | Date | Description | Changed By |
|----------|------------|---|------------|
| 0 | 05/01/2011 | Initial Product Release | - |
| 1 | 02/21/2013 | Electrical characteristics and mechanical drawing updated | JN |
| 2 | 03/16/2020 | Electrical Characteristics & Segment Layout Updated | SB |
| 3 | 10/23/2020 | Updated Supply Voltage Range: (3V/3.3V/3.5V) to (2.8V/3V/3.3V) | AS |
| 4 | 07/21/2022 | PCB redesign offering multiple driving methods. Electrical characteristics updated. Mechanical drawing updated. | CJ |

Mechanical Drawing

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



| Pin No. | Symbol |
|---------|--------------|
| 1 | VSS |
| 2 | VDD |
| 3 | NC or BC_VDD |
| 4 | D/C |
| 5 | R/W or /WR |
| 6 | E or /RD |
| 7-14 | DB0 – DB7 |
| 15 | NC or VCC |
| 16 | /RES |
| 17 | /CS |
| 18 | NC or G_VDD |
| 19 | BS1 |
| 20 | BS0 |

- Product Description: 2.8" Blue Graphic OLED
- OLED Driver IC: SSD1322
 - OLED Interface: 3-/4-wire Serial, 8-bit 6800/8080 Parallel
 - OLED Power Requirement: 3.3V/310mA
 - Mating Connector: 20 pin, 2.54mm pitch pins

| | | |
|---|--|---------------------------|
| Standard Tolerance: (Unless otherwise specified) Linear: ±0.3mm | | |
| | Drawing/Part Number: NHD-2.8-25664UCB2 | Revision: - |
| Unless otherwise specified: • Dimensions are in Millimeters • Third Angle Projection | Drawn By: C. Johnson | Approved By: C. Johnson |
| | Drawn Date: 07/21/2022 | Approved Date: 07/21/2022 |
| Do Not Scale Drawing | | Sheet 1 of 1 |
| 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. | | |

Pin 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 and logic. |
| 3 | NC or BC_VDD | - | Default: No Connect Supply Voltage for Boost Converter: See Jumper Option #1 |
| 4 | D/C | MPU | Register select signal. D/C=0: Command, D/C=1: Data |
| 5 | R/W or /WR | MPU | 6800-interface: Read/Write select signal, R/W=1: Read, R/W=0: Write 8080-interface: Active LOW Write signal. |
| 6 | E or /RD | MPU | 6800-interface: Operation enable signal. Falling edge triggered. 8080-interface: Active LOW Read signal. |
| 7-14 | DB0 – DB7 | MPU | 8-bit Bi-directional data bus lines. |
| 15 | NC or VCC | - | Default: No Connect Supply Voltage for OLED Panel: See Jumper Option #2 |
| 16 | /RES | MPU | Active LOW Reset signal. |
| 17 | /CS | MPU | Active LOW Chip Select signal. |
| 18 | NC or G_VDD | - | Default: No Connect Supply Voltage for Internal Regulator: See Jumper Option #3 |
| 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 and logic. |
| 3 | NC or BC_VDD | - | Default: No Connect Supply Voltage for Boost Converter: See Jumper Option #1 |
| 4 | D/C | MPU | Register select signal. D/C=0: Command, D/C=1: Data 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 | NC | - | No Connect |
| 10-14 | VSS | Power Supply | Ground |
| 15 | NC or VCC | - | Default: No Connect Supply Voltage for OLED Panel: See Jumper Option #2 |
| 16 | /RES | MPU | Active LOW Reset signal. |
| 17 | /CS | MPU | Active LOW Chip Select signal. |
| 18 | NC or G_VDD | - | Default: No Connect Supply Voltage for Internal Regulator: See Jumper Option #3 |
| 19 | BS1 | MPU | MPU Interface Select signal. |
| 20 | BS0 | MPU | MPU Interface Select signal. |

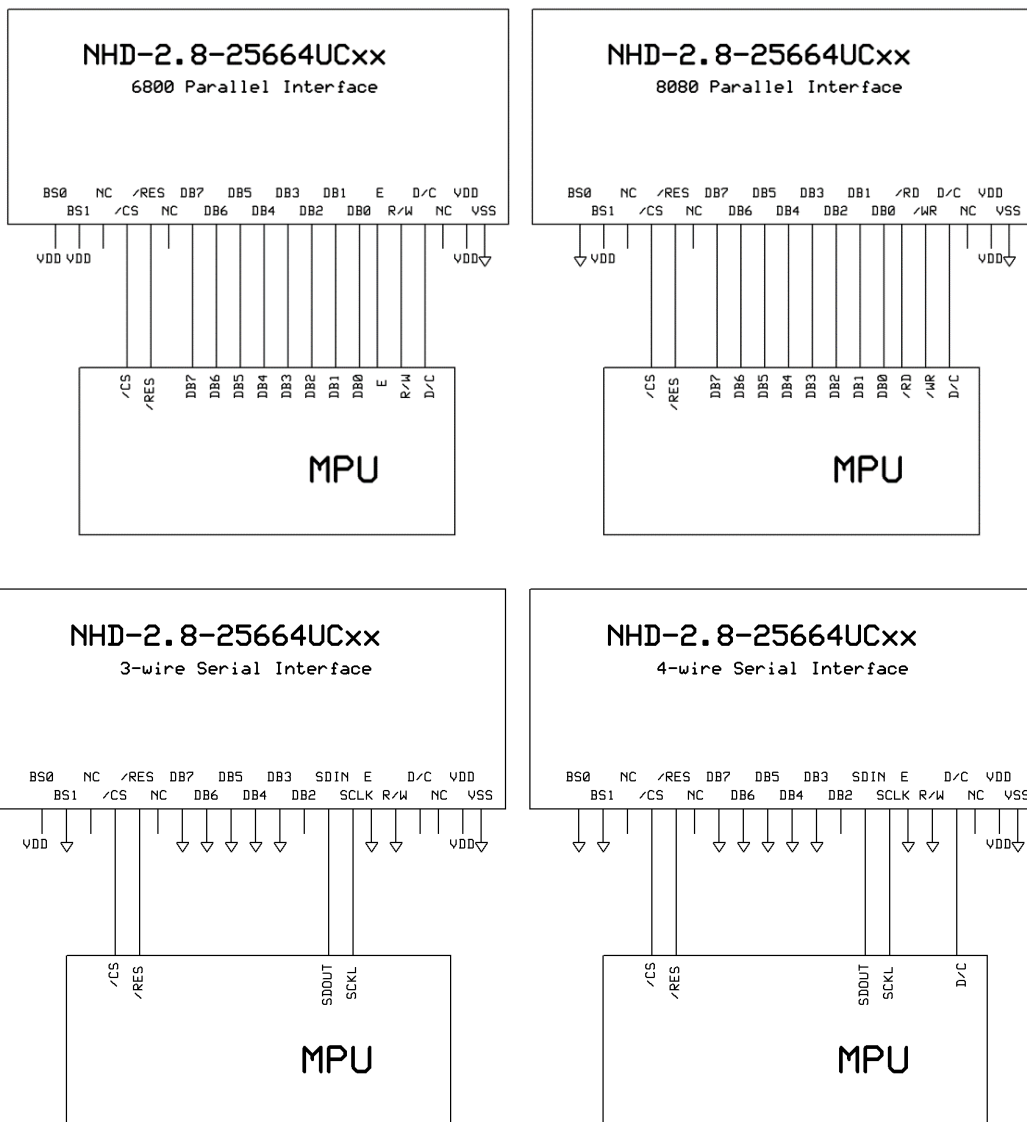
MPU Interface Pin Selections

| 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 Summary

| 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 | |

Wiring Diagrams



On-Board Jumper Options

Default Jumper Setting

| R14 | R15 | R18 | R1 | Description |
|-------|------|------|------|---|
| Close | Open | Open | Open | (default) OLED Logic Circuit + 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)

| R14 | R15 | R18 | R1 | Description |
|------|-------|------|------|--|
| Open | Close | Open | Open | Boost converter + OLED panel are powered from BC_VDD (pin #3). OLED Logic Circuit is 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). |

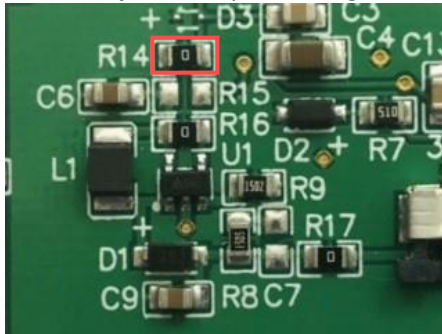
Jumper Option #2 – External Supply Voltage for OLED Panel (VCC)

| R14 | R15 | R18 | R1 | Description |
|------|------|-------|------|--|
| Open | Open | Close | Open | OLED panel is powered from VCC (pin #15) – boost converter is not used. OLED Logic Circuit is powered from VDD (pin #2). This allows for maximum module efficiency, and drastically reduced total current consumption. |

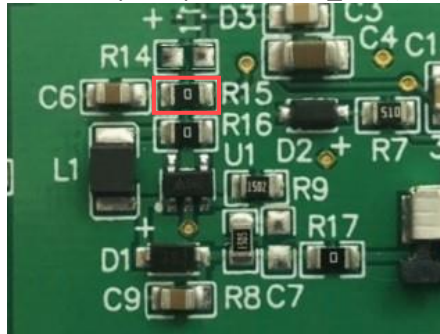
Jumper Option #3 – External Supply Voltage for Internal Regulator (G_VDD)

| R14 | R15 | R18 | R1 | Description |
|-----------------|-----|-----|-------|--|
| See Description | | | Close | OLED Internal Regulator + Logic Circuit are powered from G_VDD (pin #18) – boost converter is powered from VDD (pin #2). Disabling the internal regulator reduces power consumption. Booster circuit must be driven by alternative method. |

Default Jumper Setting



Jumper Option #1 (BC_VDD)



Jumper Option #2 (VCC)



Jumper Option #3 (G_VDD)



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

Electrical Characteristics

| 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 | - | +90 | °C |
| Default Jumper Setting | | | | | | |
| Supply Voltage for Module | VDD | - | 2.8 | 3.3 | 3.5 | V |
| Supply Current for Module | IDD | VDD=3.3V, 100% ON | - | 310 | 340 | mA |
| Jumper Option #1 | | | | | | |
| Supply Voltage for Module | VDD | - | 2.8 | 3.3 | 3.5 | V |
| Supply Current for Module | IDD | V _{DD} =3.3V | - | 170 | 200 | μA |
| Supply Voltage for Boost Converter | BC_VDD | - | 2.8 | - | 12 | V |
| Supply Current for Boost Converter | BC_IDD | BC_VDD=5.0V, 100% ON | - | 170 | 200 | mA |
| | | BC_VDD=12.0V, 100% ON | - | 70 | 80 | mA |
| Jumper Option #2 | | | | | | |
| Supply Voltage for Module | VDD | - | 2.8 | 3.3 | 3.5 | V |
| Supply Current for Module | IDD | V _{DD} =3.3V | - | 170 | 200 | μA |
| Supply Voltage for OLED Panel | VCC | - | 11.5 | 12 | 12.5 | V |
| Supply Current for OLED Panel | ICC | VCC=12V, 100% ON | - | 45 | 55 | mA |
| Jumper Option #3 | | | | | | |
| Supply Voltage for Logic | G_VDD | - | 2.4 | 2.5 | 2.6 | V |
| Supply Current for Module | G_IDD | VDD=3.3V | - | 100 | 120 | μA |
| Sleep Mode Current | IDD _{SLEEP} | - | - | 25 | 120 | μA |
| "H" Level input | V _{ih} | - | 0.8*VDD | - | VDD | V |
| "L" Level input | V _{il} | - | VSS | - | 0.2*VDD | V |
| "H" Level output | V _{oh} | - | 0.9*VDD | - | VDD | V |
| "L" Level output | V _{ol} | - | VSS | - | 0.1*VDD | 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

| Item | Symbol | Condition | Min. | Typ. | Max. | Unit |
|------------------------|----------------|------------------------|--------|--------|------|-------------------|
| Optimal Viewing Angles | Top | - | - | 80 | - | ° |
| | Bottom | | - | 80 | - | ° |
| | Left | | - | 80 | - | ° |
| | Right | | - | 80 | - | ° |
| Contrast Ratio | CR | - | 2000:1 | - | - | - |
| Response Time | Rise | T _R | - | 10 | - | us |
| | Fall | T _F | - | 10 | - | us |
| Brightness | L _V | T _{OP} = 25°C | 60 | 80 | - | cd/m ² |
| Lifetime | - | 50% Checkerboard | 10,000 | 20,000 | - | 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**. The Display OFF command can be used to extend the lifetime of the display. Luminance of active pixels will degrade faster than inactive pixels. Residual (burn-in) images may occur. To avoid this, every pixel should be illuminated uniformly.

Controller Information

Built in SSD1322 Controller

For detailed information please download datasheet: <https://support.newhavendisplay.com/hc/en-us/articles/4414477846679-SSD1322>

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 |

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 |

Alternatively, /RD and /WR can be kept stable while /CS serves as the data/command latch signal.

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

Serial Interface (4-wire)

The 4-wire serial interface consists of serial clock SCLK, serial data SDIN, D/C, and /CS.

D0 acts as SCLK and D1 acts as SDIN. D2 should be left open. 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 | ↑ |

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 GDRAM or command register in the same clock. *Note: Read is not available in serial mode*

Serial Interface (3-wire)

The 3-wire serial interface consists of serial clock SCLK, serial data SDIN, and /CS.

D0 acts as SCLK and D1 acts as SDIN. D2 should be left open. D3~D7, E, R/W, and D/C should be connected to GND.

| 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 | ↑ |

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 is not available in serial mode*

Example Initialization Sequence

```

Set_Command_Lock(0x12);           // Unlock Basic Commands (0x12/0x16)
Set_Display_On_Off(0x00);        // Display Off (0x00/0x01)
Set_Column_Address(0x1C,0x5B);
Set_Row_Address(0x00,0x3F);
Set_Display_Clock(0x91);         // Set Clock as 80 Frames/Sec
Set_Multiplex_Ratio(0x3F);       // 1/64 Duty (0x0F~0x3F)
Set_Display_Offset(0x00);        // Shift Mapping RAM Counter (0x00~0x3F)
Set_Start_Line(0x00);           // Set Mapping RAM Display Start Line (0x00~0x7F)
Set_Remap_Format(0x14);         // Set Horizontal Address Increment
                                // Column Address 0 Mapped to SEG0
                                // Disable Nibble Remap
                                // Scan from COM[N-1] to COM0
                                // Disable COM Split Odd Even
                                // Enable Dual COM Line Mode
Set_GPIO(0x00);                 // Disable GPIO Pins Input
Set_Function_Selection(0x01);    // Enable Internal VDD Regulator
Set_Display_Enhancement_A(0xA0,0xFD); // Enable External VSL
Set_Contrast_Current(0x9F);      // Set Segment Output Current
Set_Master_Current(0x0F);        // Set Scale Factor of Segment Output Current Control
//Set_Gray_Scale_Table();        // Set Pulse Width for Gray Scale Table
Set_Linear_Gray_Scale_Table();   //set default linear gray scale table
Set_Phase_Length(0xE2);         // Set Phase 1 as 5 Clocks & Phase 2 as 14 Clocks
Set_Display_Enhancement_B(0x20); // Enhance Driving Scheme Capability (0x00/0x20)
Set_Precharge_Voltage(0x1F);     // Set Pre-Charge Voltage Level as 0.60*VCC
Set_Precharge_Period(0x08);     // Set Second Pre-Charge Period as 8 Clocks
Set_VCOMH(0x07);                // Set Common Pins Deselect Voltage Level as 0.86*VCC
Set_Display_Mode(0x02);         // Normal Display Mode (0x00/0x01/0x02/0x03)
Set_Partial_Display(0x01,0x00,0x00); // Disable Partial Display
Set_Display_On_Off(0x01);

```

Quality Information

| Test Item | Content of Test | Test Condition | Note |
|---------------------------------------|--|---|------|
| High Temperature storage | Test the endurance of the display at high storage temperature. | +90°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 100 cycles | |
| Vibration test | Test the endurance of the display by applying vibration to simulate transportation and use. | 10-22Hz, 1.5mm amplitude. 22-500Hz, 1.5G 30min in each of 3 directions 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 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