

Product Specification

NHD-1.91-176176B

Graphic Color OLED Display

| | |
|----------------|---------------------|
| NHD- | Newhaven Display |
| 1.91- | 1.91" Diagonal Size |
| 176176- | 176 x 176 Pixels |
| B- | Model |

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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

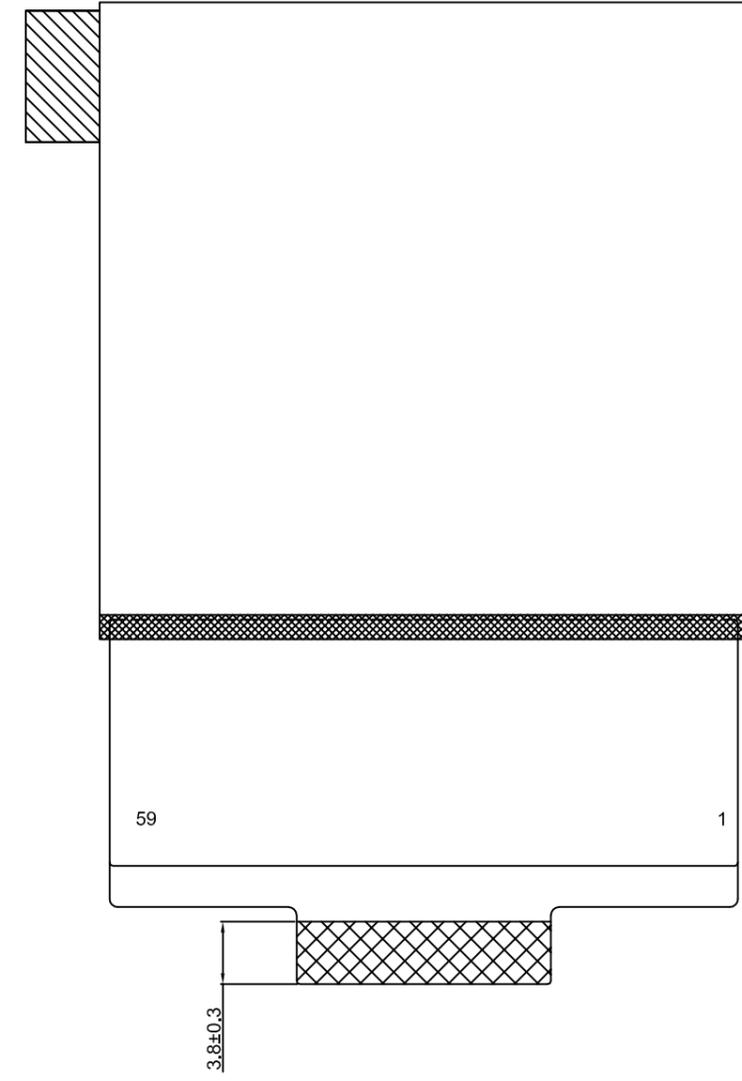
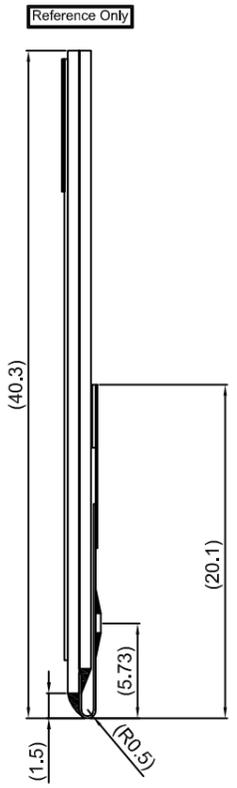
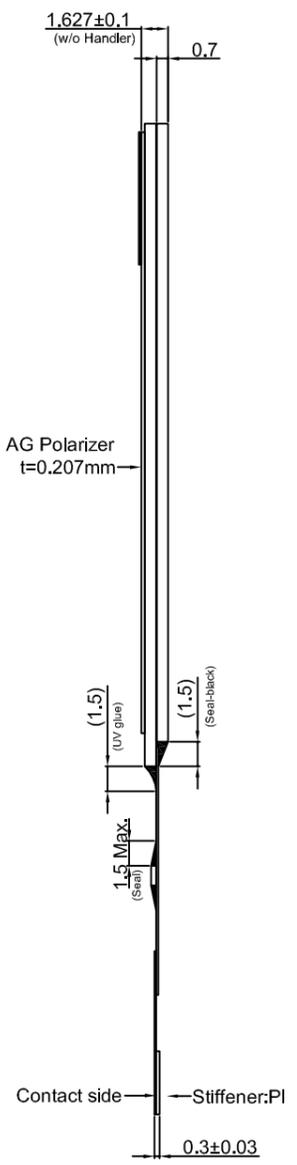
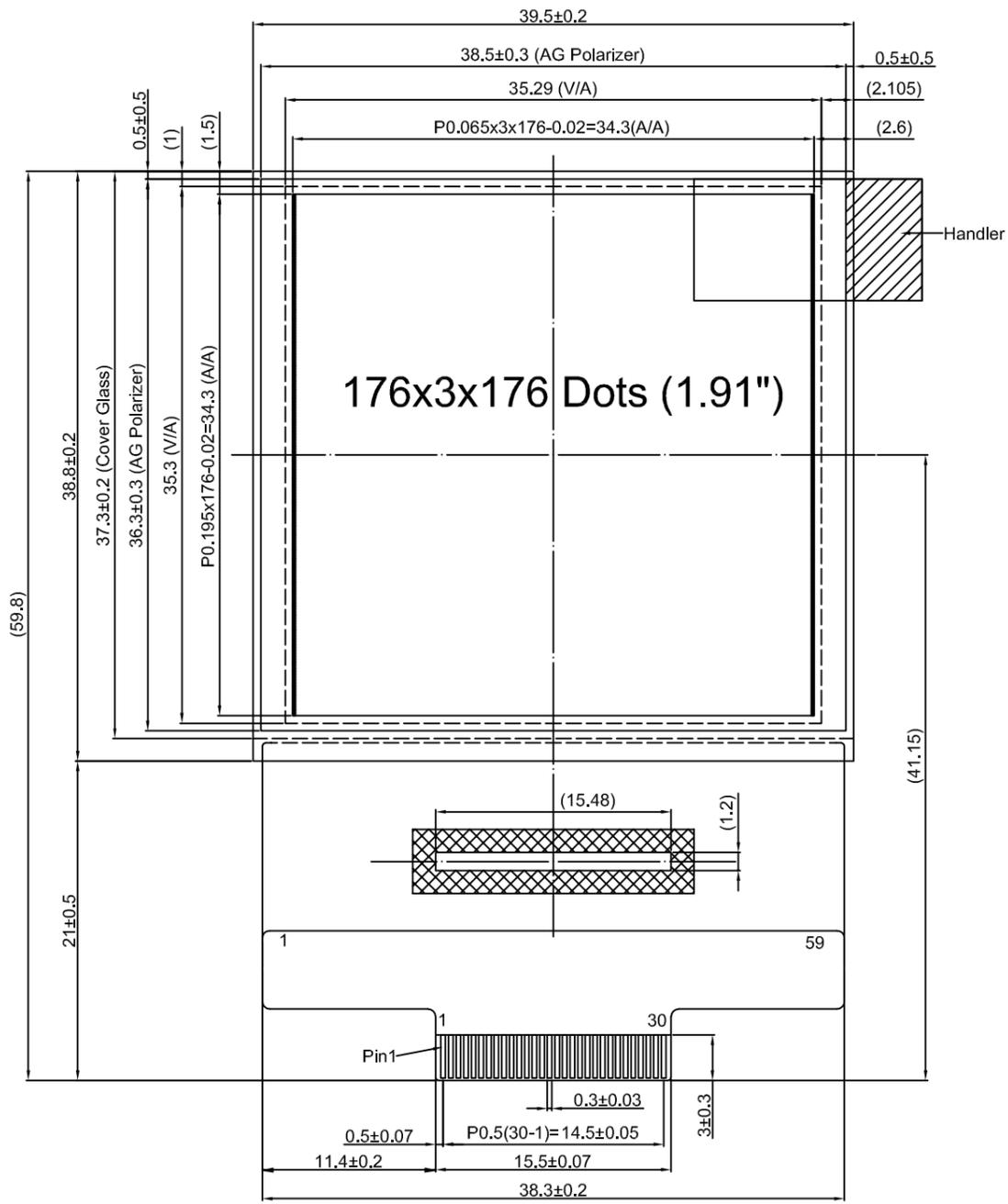
| Revision | Date | Description | Changed By |
|----------|------------|-----------------|------------|
| - | 04/29/2024 | Initial Release | KL |

Mechanical Drawing

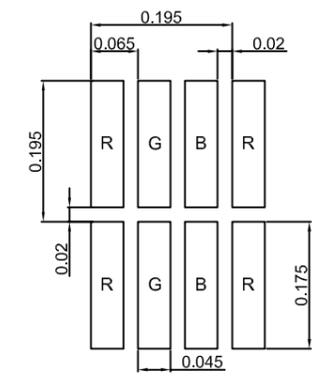
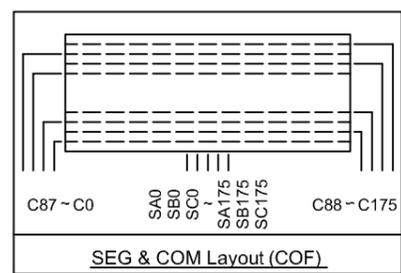
Newhaven Display

NHD-1.91-176176B
Date Code

Part Label (type/format may vary)



| Pin Assignment | |
|----------------|-----------|
| NO. | SYMBOL |
| 1 | NC |
| 2 | VLSS |
| 3 | VSL |
| 4 | VCOMH |
| 5 | VCC |
| 6 | D7 |
| 7 | D6 |
| 8 | D5 |
| 9 | D4 |
| 10 | D3 |
| 11 | D2 |
| 12 | D1 |
| 13 | D0 |
| 14 | E(RD#) |
| 15 | R/W#(WR#) |
| 16 | BS1 |
| 17 | BS2 |
| 18 | CS# |
| 19 | D/C# |
| 20 | RES# |
| 21 | FR |
| 22 | VDD |
| 23 | VSS |
| 24 | IREF |
| 25 | VCC |
| 26 | VP |
| 27 | VCOMH |
| 28 | VSL |
| 29 | VLSS |
| 30 | NC |



- Product Description: 1.91" 176x176 Color OLED**
1. Driver IC: SSD1333
 2. Interface: 8-bit 6800/8080 Parallel, 4-wire SPI, I²C
 3. Power Requirement: 1.8V OLED
 4. Optical Features: Full Color, Full View
 5. Recommended FFC Connector: 30pin 0.5mm pitch; Ex. Molex 54104-3031

| | | |
|---|---|---------------------------|
| Standard Tolerance: (Unless otherwise specified) Linear: ±0.3mm | | |
| | Drawing/Part Number: NHD-1.91-176176B | Revision: 1A |
| Unless otherwise specified: • Dimensions are in Millimeters • Third Angle Projection | Drawn By: K. Lewis | Approved By: K. Lewis |
| | Drawn Date: 04/29/2024 | Approved Date: 04/29/2024 |
| 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

| Pin No. | Symbol | External Connection | Function Description |
|---------|---------------|---------------------|---|
| 1 | NC | - | No Connect |
| 2 | VLSS | Power Supply | Ground |
| 3 | VSL | - | Voltage for Low Level SEG Signal |
| 4 | VCOMH | - | Voltage for High Level COM Signal |
| 5 | VCC | Power Supply | Supply Voltage for OLED Panel (+14V) |
| 6-13 | D7-D0 | MPU | Parallel Interface: 8-bit Bi-directional data bus 4-wire SPI Interface: D0 - Serial Clock signal (SCLK) D1 - Serial Data Input signal (SDIN) - connect together with D2 I²C Interface: D0 - Serial Clock signal (SCL) D1 - Serial Data Input signal (SDA _{IN}) D2 - Serial Data Output signal (SDA _{OUT}) |
| 14 | E (RD#) | MPU | 6800 mode: Enable signal. Falling edge triggered 8080 mode: Active LOW Read signal |
| 15 | R/W# (WR#) | MPU | 6800 mode: Read/Write signal. HIGH: Read, LOW: Write 8080 mode: Active LOW Write signal |
| 16 | BS1 | MPU | MPU Interface Select signal |
| 17 | BS2 | MPU | MPU Interface Select signal |
| 18 | CS# | MPU | Active LOW Chip Select signal |
| 19 | D/C# SA0 | MPU | Data/Command Control signal. HIGH: Data, LOW: Command I²C: Slave address selection signal |
| 20 | RES# | MPU | Active LOW Reset signal |
| 21 | FR | MPU | RAM write synchronization signal (No Connect if not used) |
| 22 | VDD | Power Supply | Supply Voltage for Core Logic Circuit (+3V) |
| 23 | VSS | Power Supply | Ground |
| 24 | IREF | - | Current for SEG Brightness |
| 25 | VCC | Power Supply | Supply Voltage for OLED Panel (+14V) |
| 26 | VP | - | Voltage for SEG pre-charge |
| 27 | VCOMH | - | Voltage for High Level COM signal |
| 28 | VSL | - | Voltage for Low Level SEG signal |
| 29 | VLSS | Power Supply | Ground |
| 30 | NC | - | No Connect |

Recommended display connector: 30pin 0.5mm pitch top contact FFC connector (Molex 54104-3031)

Interface Selection

MPU Interface Pin Selections and Assignment Summary

| | 6800 Parallel | 8080 Parallel | 4-Wire SPI | I ² C |
|-----|---------------|---------------|------------|------------------|
| BS1 | 0 | 1 | 0 | 1 |
| BS2 | 1 | 1 | 0 | 0 |

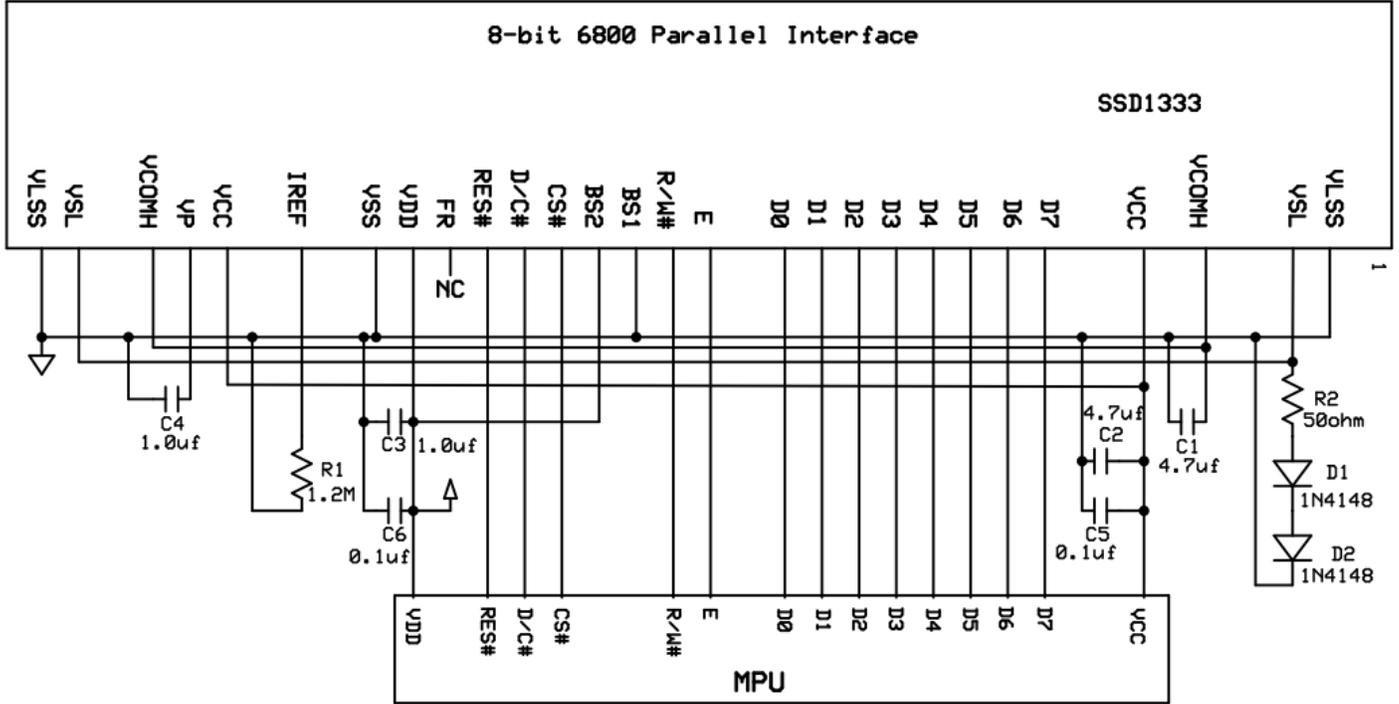
| Bus Interface | Data/Command Interface | | | | | | | Control Signals | | | | |
|-----------------------|------------------------|----|----|----|----|--------------------|-------------------|-----------------|---------|------|------|------|
| | D7 | D6 | D5 | D4 | D3 | D2 | D1 | D0 | E | R/W# | CS# | D/C# |
| 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# |
| 4-Wire SPI | Tie Low | | | | | SDIN | SCLK | Tie Low | | CS# | D/C# | RES# |
| I²C | Tie Low | | | | | SDA _{OUT} | SDA _{IN} | SCL | Tie Low | | SA0 | RES# |

I²C Interface: SDA_{IN} and SDA_{OUT} are tied together and serve as SDA. The SDA_{IN} pin must be connected to act as SDA. The SDA_{OUT} pin may be disconnected. When SDA_{OUT} pin is disconnected, the acknowledgement signal will be ignored in the I²C-bus.

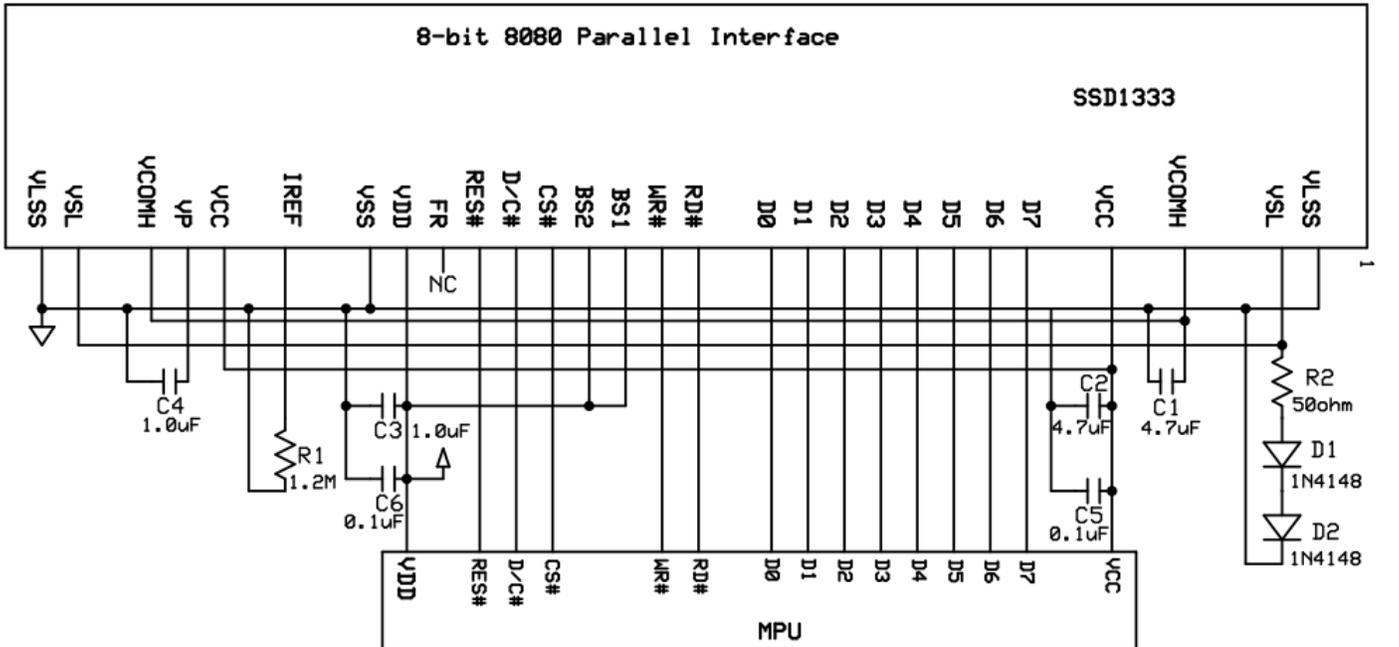


Wiring Diagram

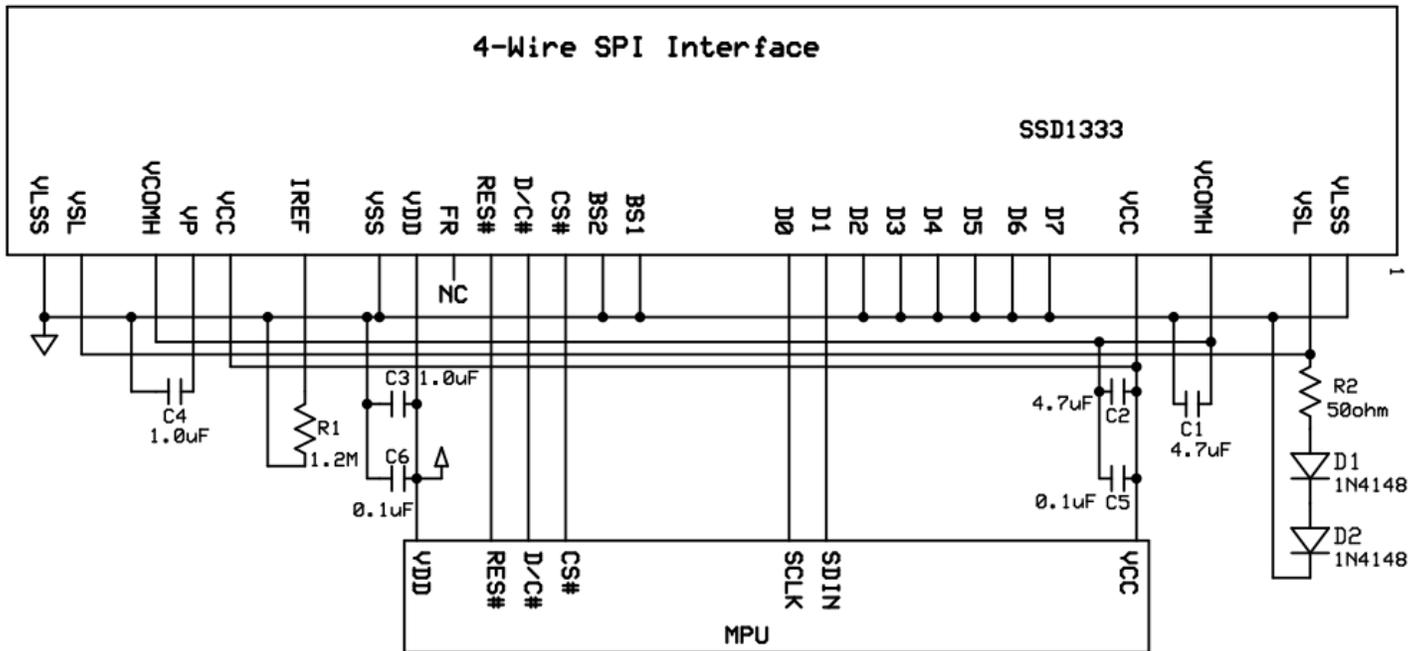
6800 Parallel Interface



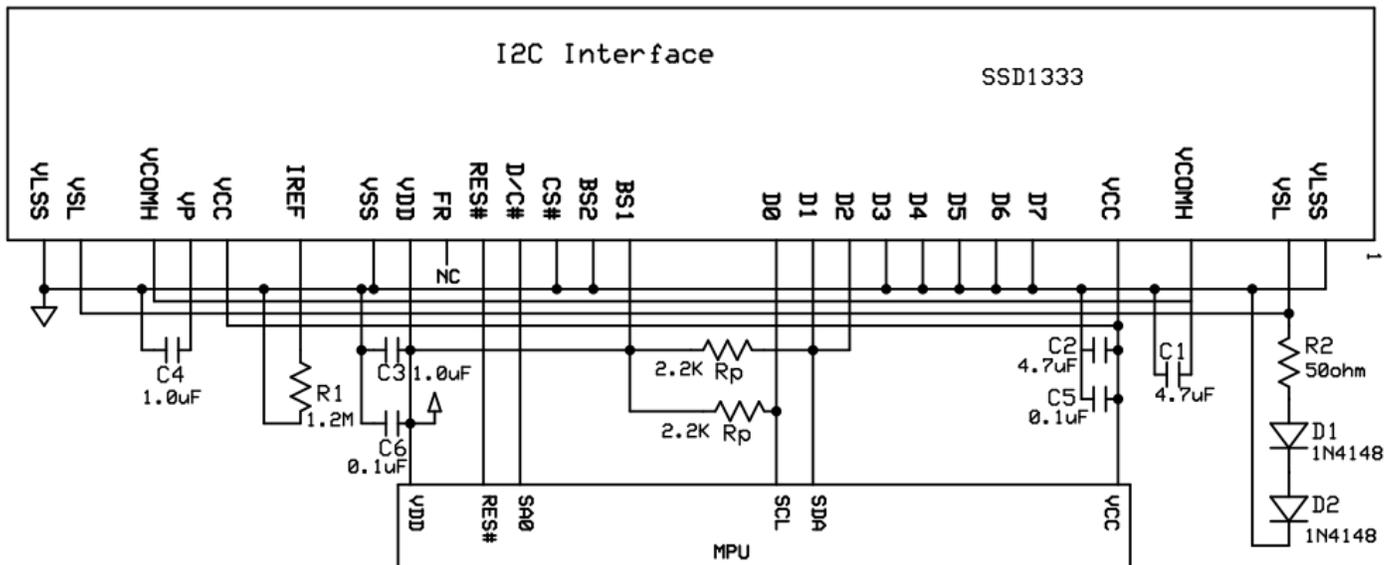
8080 Parallel Interface



4-Wire SPI Interface



I²C Interface



Electrical Characteristics

| Item | Symbol | Condition | Min. | Typ. | Max. | Unit |
|-----------------------------|-----------------------|-------------------------------|---------------------|------|---------------------|------|
| Operating Temperature Range | T _{OP} | Absolute Max | -40 | - | +70 | °C |
| Storage Temperature Range | T _{ST} | Absolute Max | -40 | - | +85 | °C |
| Supply Voltage for Logic | V _{DD} | - | 1.65 | 1.8 | 3.5 | V |
| Supply Voltage for Display | V _{CC} | - | 16.5 | 17 | 17.5 | V |
| Supply Current (Display) | I _{CC} | V _{CC} =17V, 100% ON | - | 58 | 60 | mA |
| Sleep mode Current | I _{CC_SLEEP} | V _{CI} = 1.8V | - | - | 10 | 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 |

Optical Characteristics

| Item | Symbol | Condition | Min. | Typ. | Max. | Unit | |
|------------------------|----------------|---|-----------|------|------|-------------------|---|
| Optimal Viewing Angles | Top | - | - | 80 | - | ° | |
| | Bottom | | - | 80 | - | ° | |
| | Left | | - | 80 | - | ° | |
| | Right | | - | 80 | - | ° | |
| Contrast Ratio | CR | - | >10,000:1 | - | - | | |
| Response Time | Rise | - | - | 10 | - | μs | |
| | Fall | | - | 10 | - | μs | |
| Brightness | L _V | - | 70 | 80 | - | cd/m ² | |
| Lifetime | - | 80cd/m ² , T _{OP} =25°C, 50% Checkerboard | 16,500 | - | - | Hrs. | |
| Chromaticity | Red | X _R | - | 0.62 | 0.66 | 0.70 | - |
| | | Y _R | - | 0.29 | 0.33 | 0.37 | - |
| | Green | X _G | - | 0.26 | 0.30 | 0.34 | - |
| | | Y _G | - | 0.59 | 0.63 | 0.67 | - |
| | Blue | X _B | - | 0.10 | 0.14 | 0.18 | - |
| | | Y _B | - | 0.14 | 0.18 | 0.22 | - |
| | White | X _W | - | 0.26 | 0.30 | 0.34 | - |
| | | Y _W | - | 0.29 | 0.33 | 0.37 | - |

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 SSD1333 Controller: <https://support.newhavendisplay.com/hc/en-us/articles/11256414111767-SSD1333>



Table of Commands

| Fundamental Command Table | | | | | | | | | | | |
|---------------------------|--------|----------------|----------------|----------------|----------------|----------------|----------------|----------------|----------------|---|--|
| D/C# | Hex | D7 | D6 | D5 | D4 | D3 | D2 | D1 | D0 | Command | Description |
| 0 | 15 | 0 | 0 | 0 | 1 | 0 | 1 | 0 | 1 | Set Column Address | A[7:0]: Start Address. [reset=0] B[7:0]: End Address. [reset=175d] Ranges from 0 to 175 |
| 1 | A[7:0] | A ₇ | A ₆ | A ₅ | A ₄ | A ₃ | A ₂ | A ₁ | A ₀ | | |
| 1 | B[7:0] | B ₇ | B ₆ | B ₅ | B ₄ | B ₃ | B ₂ | B ₁ | B ₀ | | |
| 0 | 75 | 0 | 1 | 1 | 1 | 0 | 1 | 0 | 1 | Set Row Address | A[7:0]: Start Address. [reset=0] B[7:0]: End Address. [reset=175d] Ranges from 0 to 175 |
| 1 | A[7:0] | A ₇ | A ₆ | A ₅ | A ₄ | A ₃ | A ₂ | A ₁ | A ₀ | | |
| 1 | B[7:0] | B ₇ | B ₆ | B ₅ | B ₄ | B ₃ | B ₂ | B ₁ | B ₀ | | |
| 0 | 5C | 0 | 1 | 0 | 1 | 1 | 1 | 0 | 0 | Write RAM Command | Enable MCU to write Data into RAM |
| 0 | 5D | 0 | 1 | 0 | 1 | 1 | 1 | 0 | 1 | Read RAM Command | Enable MCU to read Data from RAM |
| 0 | A0 | 1 | 0 | 1 | 0 | 0 | 0 | 0 | 0 | Set Re-map / Color Depth (Display RAM to Panel) | A[0]=0b, Horizontal address increment [reset] A[0]=1b, Vertical address increment |
| 1 | A[7:0] | A ₇ | A ₆ | A ₅ | A ₄ | A ₃ | A ₂ | A ₁ | A ₀ | | <p>A[1]=0b, Column address 0 is mapped to SEG0 [reset] A[1]=1b, Column address 175 is mapped to SEG0</p> <p>A[2]=0b, Color sequence: A → B → C [reset] A[2]=1b, Color sequence is swapped: C → B → A</p> <p>A[3]=0b, Reserved [reset] A[3]=1b, Reserved</p> <p>A[4]=0b, Scan from COM0 to COM[N-1] [reset] A[4]=1b, Scan from COM[N-1] to COM0. Where N is the Multiplex ratio.</p> <p>A[5]=0b, Disable COM Split Odd Even A[5]=1b, Enable COM Split Odd Even [reset]</p> <p>A[7:6] Set Color Depth, 00b: 256color 01b: 65k color [reset] 10b: 262k color 11b Pseudo 262k color, 16-bit format 2</p> <p>Refer to Product Preview Table 6-7 for details</p> |

| Fundamental Command Table | | | | | | | | | | | |
|---------------------------|--------------|---------------------|---------------------|---------------------|---------------------|---------------------|---------------------|---------------------|---------------------|---|---|
| D/C# | Hex | D7 | D6 | D5 | D4 | D3 | D2 | D1 | D0 | Command | Description |
| 0 1 | A1 A[7:0] | 1 A ₇ | 0 A ₆ | 1 A ₅ | 0 A ₄ | 0 A ₃ | 0 A ₂ | 0 A ₁ | 1 A ₀ | Set Display Start Line | Set vertical scroll by RAM from 0~175. [reset=00h] |
| 0 1 | A2 A[7:0] | 1 A ₇ | 0 A ₆ | 1 A ₅ | 0 A ₄ | 0 A ₃ | 0 A ₂ | 1 A ₁ | 0 A ₀ | Set Display Offset | Set vertical scroll by Row from 0-175. [reset=00h] |
| 0 | A4~A7 | 1 | 0 | 1 | 0 | 0 | 1 | X ₁ | X ₀ | Set Display Mode | A4h: All OFF A5h: All ON (All pixels have GS63) A6h : Reset to normal display [reset] A7h: Inverse Display (GS0 -> GS63, GS1 -> GS62,) |
| 0 | AE~AF | 1 | 0 | 1 | 0 | 1 | 1 | 1 | X ₀ | Set Sleep mode ON/OFF | A Eh = Sleep mode On (Display OFF) A Fh = Sleep mode OFF (Display ON) |
| 0 1 | B1 A[7:0] | 1 A ₇ | 0 A ₆ | 1 A ₅ | 1 A ₄ | 0 A ₃ | 0 A ₂ | 0 A ₁ | 1 A ₀ | Set Reset (Phase 1) / Pre-charge (Phase 2) period | A[3:0] Phase 1 period of 2~30 DCLK(s) clocks [reset=0100b] A[3:0]: 0 invalid 1 = 2 DCLKs 2 = 4 DCLKs : 15 = 30DCLKs A[7:4] Phase 2 period of 2~30 DCLK(s) clocks [reset=1000b] A[7:4]: 0 invalid 1 = 2 DCLKs 2 = 4 DCLKs : 15 =30DCLKs Note (1) 0 DCLK is invalid in phase 1 & phase 2 |

Fundamental Command Table

| D/C# | Hex | D7 | D6 | D5 | D4 | D3 | D2 | D1 | D0 | Command | Description | | | | | | | | | | | | | | | | | | | | | | |
|---------------------------------|---|--|--|--|--|--|--|--|--|---|--|--------|--------|------|-------------|------|-------------|------|-------------|------|-------------|------|--------------|------|--------------|------|--------------|------|---------------|------|---------------|--------|---------|
| 0 1 | B3 A[7:0] | 1 A ₇ | 0 A ₆ | 1 A ₅ | 1 A ₄ | 0 A ₃ | 0 A ₂ | 1 A ₁ | 1 A ₀ | Front Clock Divider (DivSet)/ Oscillator Frequency | <p>A[3:0] [reset=0000b], divide by DIVSET where</p> <table border="1"> <thead> <tr> <th>A[3:0]</th> <th>DIVSET</th> </tr> </thead> <tbody> <tr><td>0000</td><td>divide by 1</td></tr> <tr><td>0001</td><td>divide by 2</td></tr> <tr><td>0010</td><td>divide by 4</td></tr> <tr><td>0011</td><td>divide by 8</td></tr> <tr><td>0100</td><td>divide by 16</td></tr> <tr><td>0101</td><td>divide by 32</td></tr> <tr><td>0110</td><td>divide by 64</td></tr> <tr><td>0111</td><td>divide by 128</td></tr> <tr><td>1000</td><td>divide by 256</td></tr> <tr><td>>=1001</td><td>invalid</td></tr> </tbody> </table> <p>A[7:4] Oscillator frequency, frequency increases as level increases [reset=1001b]</p> | A[3:0] | DIVSET | 0000 | divide by 1 | 0001 | divide by 2 | 0010 | divide by 4 | 0011 | divide by 8 | 0100 | divide by 16 | 0101 | divide by 32 | 0110 | divide by 64 | 0111 | divide by 128 | 1000 | divide by 256 | >=1001 | invalid |
| A[3:0] | DIVSET | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| 0000 | divide by 1 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| 0001 | divide by 2 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| 0010 | divide by 4 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| 0011 | divide by 8 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| 0100 | divide by 16 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| 0101 | divide by 32 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| 0110 | divide by 64 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| 0111 | divide by 128 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| 1000 | divide by 256 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| >=1001 | invalid | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| 0 1 | B6 A[3:0] | 1 0 | 0 0 | 1 0 | 1 0 | 0 A ₃ | 1 A ₂ | 0 A ₁ | 0 A ₀ | Set Second Pre-charge Period | <p>A[3:0] Set Second Pre-charge Period</p> <p>0000b invalid 0001b 1 DCLKS 0010b 2 DCLKS 1000 8 DCLKS [reset] 1111 15 DCLKS</p> | | | | | | | | | | | | | | | | | | | | | | |
| 0 1 1 1 1 1 1 | B8 A1[7:0] A2[7:0] . . . A62[7:0] A63[7:0] | 1 A1 ₇ A2 ₇ . . . A62 ₇ A63 ₇ | 0 A1 ₆ A2 ₆ . . . A62 ₆ A63 ₆ | 1 A1 ₅ A2 ₅ . . . A62 ₅ A63 ₅ | 1 A1 ₄ A2 ₄ . . . A62 ₄ A63 ₄ | 1 A1 ₃ A2 ₃ . . . A62 ₃ A63 ₃ | 0 A1 ₂ A2 ₂ . . . A62 ₂ A63 ₂ | 0 A1 ₁ A2 ₁ . . . A62 ₁ A63 ₁ | 0 A1 ₀ A2 ₀ . . . A62 ₀ A63 ₀ | Master Look Up Table for Gray Scale Pulse width (Color A,B,C) | <p>The next 63 data bytes define Gray Scale (GS) Table by setting the gray scale pulse width in unit of DCLK's (ranges from 0d ~ 180d).</p> <p>A1[7:0]: Gamma Setting for GS1, A2[7:0]: Gamma Setting for GS2, A62[7:0]: Gamma Setting for GS62, A63[7:0]: Gamma Setting for GS63</p> <p>Note</p> <p>⁽¹⁾ 0 ≤ Setting of GS1 < Setting of GS2 < Setting of GS3..... < Setting of GS62 < Setting of GS63</p> <p>⁽²⁾ GS0 does not has pre-charge and current drive stages.</p> <p>⁽³⁾ GS1 can be set as only pre-charge but no current drive stage by input gamma setting for GS1 equals 0.</p> <p>⁽⁴⁾ When command B8h is input only, color A, B, C will follow the master LUT.</p> <p>⁽⁵⁾ When command BCh is input, it selects individual LUT for color A, GS1~31A; When command BDh is input, it selects individual LUT for color C, GS1~31C</p> <p>⁽⁶⁾ To select individual LUT for color B, A and C, command B8h should be input before command BCh and BDh,</p> | | | | | | | | | | | | | | | | | | | | | | |

| Fundamental Command Table | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
|---------------------------|------------------|--------------------------------|------------------|------------------|------------------|------------------|------------------|------------------|------------------|---|--|--|---------|----------|--------------------|---------------|---------------|------------------------|---------------|---------------|---------------|---------------|---------------|--------------------------------|-----|-----|------------------|------------------|------------------|--------------------------|--|--|--|--|--|--|--|--|--|--|--|---|----|---|---|---|---|---|---|---|---|------------------------|--|---|--------|---|---|---|----------------|----------------|----------------|----------------|----------------|--|--------|----------|--------------------|-------|-----|------------------------|---|---|---|-------|-----|--------------------------------|---|---|---|-------|-----|--------------------------|--|--|--|--|--|--|--|--|--|--|--|--|---|----|---|---|---|---|---|---|---|---|---|--|---|---------|-----------------|-----------------|-----------------|-----------------|-----------------|-----------------|-----------------|-----------------|----------------------------------|---|---------|-----------------|-----------------|-----------------|-----------------|-----------------|-----------------|-----------------|-----------------|----------------------------------|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|----------|------------------|------------------|------------------|------------------|------------------|------------------|------------------|------------------|------------------------------------|---|----------|------------------|------------------|------------------|------------------|------------------|------------------|------------------|------------------|-----------------------------------|--|--|--|--|--|--|--|--|--|--|--|---|
| D/C# | Hex | D7 | D6 | D5 | D4 | D3 | D2 | D1 | D0 | Command | Description | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| 0 | B9 | 1 | 0 | 1 | 1 | 1 | 0 | 0 | 1 | Use Built-in Linear LUT [reset= linear] | Reset to default Look Up Table: | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| | | | | | | | | | | | <table border="1"> <thead> <tr> <th>Color A</th> <th>Color B</th> <th>Color C</th> </tr> </thead> <tbody> <tr> <td>GS1A = 0 DCLK</td> <td>GS1B = 0 DCLK</td> <td>GS1C = 0 DCLK</td> </tr> <tr> <td>GS2A = 4 DCLK</td> <td>GS2B = 2 DCLK</td> <td>GS2C = 4 DCLK</td> </tr> <tr> <td>GS3A = 8 DCLK</td> <td>GS3B = 4 DCLK</td> <td>GS3C = 8 DCLK</td> </tr> <tr> <td>...</td> <td>...</td> <td>...</td> </tr> <tr> <td>GS31A = 120 DCLK</td> <td>GS62B = 122 DCLK</td> <td>GS31C = 120 DCLK</td> </tr> <tr> <td></td> </tr> <tr> <td>0</td> <td>BB</td> <td>1</td> <td>0</td> <td>1</td> <td>1</td> <td>1</td> <td>0</td> <td>1</td> <td>1</td> <td rowspan="2">Set Pre-charge voltage</td> <td rowspan="2">Set pre-charge voltage level. [reset = 01111b]</td> </tr> <tr> <td>1</td> <td>A[4:0]</td> <td>0</td> <td>0</td> <td>0</td> <td>A₄</td> <td>A₃</td> <td>A₂</td> <td>A₁</td> <td>A₀</td> <td> <table border="1"> <thead> <tr> <th>A[4:0]</th> <th>Hex code</th> <th>pre-charge voltage</th> </tr> </thead> <tbody> <tr> <td>00000</td> <td>00h</td> <td>0.10 x V_{CC}</td> </tr> <tr> <td>:</td> <td>:</td> <td>:</td> </tr> <tr> <td>10111</td> <td>17h</td> <td>0.40 x V_{CC} [reset]</td> </tr> <tr> <td>:</td> <td>:</td> <td>:</td> </tr> <tr> <td>11111</td> <td>1Fh</td> <td>0.5133 x V_{CC}</td> </tr> </tbody> </table> </td> </tr> <tr> <td></td> <td> <p>Note</p> <p>⁽¹⁾Pre-charge voltage level must be smaller than COM deselect voltage level</p> </td> </tr> <tr> <td>0</td> <td>BC</td> <td>1</td> <td>0</td> <td>1</td> <td>1</td> <td>1</td> <td>1</td> <td>0</td> <td>0</td> <td rowspan="8">Individual Look Up Table for Gray Scale Pulse width (Color A)</td> <td rowspan="8">The next 31 data bytes define Gray Scale (GS) Table by setting the gray scale pulse width in unit of DCLK's (ranges from 0d ~ 180d) for color A.</td> </tr> <tr> <td>1</td> <td>A1[7:0]</td> <td>A1₇</td> <td>A1₆</td> <td>A1₅</td> <td>A1₄</td> <td>A1₃</td> <td>A1₂</td> <td>A1₁</td> <td>A1₀</td> <td>A1[7:0]: Gamma Setting for GS1A,</td> </tr> <tr> <td>1</td> <td>A2[7:0]</td> <td>A2₇</td> <td>A2₆</td> <td>A2₅</td> <td>A2₄</td> <td>A2₃</td> <td>A2₂</td> <td>A2₁</td> <td>A2₀</td> <td>A2[7:0]: Gamma Setting for GS2A,</td> </tr> <tr> <td>1</td> <td>.</td> <td>.</td> <td>.</td> <td>.</td> <td>.</td> <td>.</td> <td>.</td> <td>.</td> <td>.</td> <td>:</td> </tr> <tr> <td>1</td> <td>.</td> </tr> <tr> <td>1</td> <td>.</td> </tr> <tr> <td>1</td> <td>A30[7:0]</td> <td>A30₇</td> <td>A30₆</td> <td>A30₅</td> <td>A30₄</td> <td>A30₃</td> <td>A30₂</td> <td>A30₁</td> <td>A30₀</td> <td>A30[7:0]: Gamma Setting for GS30A,</td> </tr> <tr> <td>1</td> <td>A31[7:0]</td> <td>A31₇</td> <td>A31₆</td> <td>A31₅</td> <td>A31₄</td> <td>A31₃</td> <td>A31₂</td> <td>A31₁</td> <td>A31₀</td> <td>A31[7:0]: Gamma Setting for GS31A</td> </tr> <tr> <td></td> <td> <p>Note</p> <p>⁽¹⁾ 0 ≤ Setting of GS1 < Setting of GS2 < Setting of GS3..... < Setting of GS30 < Setting of GS31</p> <p>⁽²⁾ GS0 does not has pre-charge and current drive stages.</p> <p>⁽³⁾ GS1 can be set as only pre-charge but no current drive stage by input gamma setting for GS1 equals 0.</p> <p>⁽⁴⁾ When command B8h is input, it selects one LUT for color A, B and C. i.e. GS1~31A, GS1~63B and GS1~31C are updated.</p> <p>⁽⁵⁾ Command B8h should be input before command BCh and BDh to select individual LUT for color B, A and C.</p> </td> </tr> </tbody> </table> | Color A | Color B | Color C | GS1A = 0 DCLK | GS1B = 0 DCLK | GS1C = 0 DCLK | GS2A = 4 DCLK | GS2B = 2 DCLK | GS2C = 4 DCLK | GS3A = 8 DCLK | GS3B = 4 DCLK | GS3C = 8 DCLK | ... | ... | ... | GS31A = 120 DCLK | GS62B = 122 DCLK | GS31C = 120 DCLK | | | | | | | | | | | | | 0 | BB | 1 | 0 | 1 | 1 | 1 | 0 | 1 | 1 | Set Pre-charge voltage | Set pre-charge voltage level. [reset = 01111b] | 1 | A[4:0] | 0 | 0 | 0 | A ₄ | A ₃ | A ₂ | A ₁ | A ₀ | <table border="1"> <thead> <tr> <th>A[4:0]</th> <th>Hex code</th> <th>pre-charge voltage</th> </tr> </thead> <tbody> <tr> <td>00000</td> <td>00h</td> <td>0.10 x V_{CC}</td> </tr> <tr> <td>:</td> <td>:</td> <td>:</td> </tr> <tr> <td>10111</td> <td>17h</td> <td>0.40 x V_{CC} [reset]</td> </tr> <tr> <td>:</td> <td>:</td> <td>:</td> </tr> <tr> <td>11111</td> <td>1Fh</td> <td>0.5133 x V_{CC}</td> </tr> </tbody> </table> | A[4:0] | Hex code | pre-charge voltage | 00000 | 00h | 0.10 x V _{CC} | : | : | : | 10111 | 17h | 0.40 x V _{CC} [reset] | : | : | : | 11111 | 1Fh | 0.5133 x V _{CC} | | | | | | | | | | | | <p>Note</p> <p>⁽¹⁾Pre-charge voltage level must be smaller than COM deselect voltage level</p> | 0 | BC | 1 | 0 | 1 | 1 | 1 | 1 | 0 | 0 | Individual Look Up Table for Gray Scale Pulse width (Color A) | The next 31 data bytes define Gray Scale (GS) Table by setting the gray scale pulse width in unit of DCLK's (ranges from 0d ~ 180d) for color A. | 1 | A1[7:0] | A1 ₇ | A1 ₆ | A1 ₅ | A1 ₄ | A1 ₃ | A1 ₂ | A1 ₁ | A1 ₀ | A1[7:0]: Gamma Setting for GS1A, | 1 | A2[7:0] | A2 ₇ | A2 ₆ | A2 ₅ | A2 ₄ | A2 ₃ | A2 ₂ | A2 ₁ | A2 ₀ | A2[7:0]: Gamma Setting for GS2A, | 1 | . | . | . | . | . | . | . | . | . | : | 1 | . | . | . | . | . | . | . | . | . | . | 1 | . | . | . | . | . | . | . | . | . | . | 1 | A30[7:0] | A30 ₇ | A30 ₆ | A30 ₅ | A30 ₄ | A30 ₃ | A30 ₂ | A30 ₁ | A30 ₀ | A30[7:0]: Gamma Setting for GS30A, | 1 | A31[7:0] | A31 ₇ | A31 ₆ | A31 ₅ | A31 ₄ | A31 ₃ | A31 ₂ | A31 ₁ | A31 ₀ | A31[7:0]: Gamma Setting for GS31A | | | | | | | | | | | | <p>Note</p> <p>⁽¹⁾ 0 ≤ Setting of GS1 < Setting of GS2 < Setting of GS3..... < Setting of GS30 < Setting of GS31</p> <p>⁽²⁾ GS0 does not has pre-charge and current drive stages.</p> <p>⁽³⁾ GS1 can be set as only pre-charge but no current drive stage by input gamma setting for GS1 equals 0.</p> <p>⁽⁴⁾ When command B8h is input, it selects one LUT for color A, B and C. i.e. GS1~31A, GS1~63B and GS1~31C are updated.</p> <p>⁽⁵⁾ Command B8h should be input before command BCh and BDh to select individual LUT for color B, A and C.</p> |
| Color A | Color B | Color C | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| GS1A = 0 DCLK | GS1B = 0 DCLK | GS1C = 0 DCLK | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| GS2A = 4 DCLK | GS2B = 2 DCLK | GS2C = 4 DCLK | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| GS3A = 8 DCLK | GS3B = 4 DCLK | GS3C = 8 DCLK | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
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| GS31A = 120 DCLK | GS62B = 122 DCLK | GS31C = 120 DCLK | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
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| 0 | BB | 1 | 0 | 1 | 1 | 1 | 0 | 1 | 1 | Set Pre-charge voltage | Set pre-charge voltage level. [reset = 01111b] | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| 1 | A[4:0] | 0 | 0 | 0 | A ₄ | A ₃ | A ₂ | A ₁ | A ₀ | | | <table border="1"> <thead> <tr> <th>A[4:0]</th> <th>Hex code</th> <th>pre-charge voltage</th> </tr> </thead> <tbody> <tr> <td>00000</td> <td>00h</td> <td>0.10 x V_{CC}</td> </tr> <tr> <td>:</td> <td>:</td> <td>:</td> </tr> <tr> <td>10111</td> <td>17h</td> <td>0.40 x V_{CC} [reset]</td> </tr> <tr> <td>:</td> <td>:</td> <td>:</td> </tr> <tr> <td>11111</td> <td>1Fh</td> <td>0.5133 x V_{CC}</td> </tr> </tbody> </table> | A[4:0] | Hex code | pre-charge voltage | 00000 | 00h | 0.10 x V _{CC} | : | : | : | 10111 | 17h | 0.40 x V _{CC} [reset] | : | : | : | 11111 | 1Fh | 0.5133 x V _{CC} | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| A[4:0] | Hex code | pre-charge voltage | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| 00000 | 00h | 0.10 x V _{CC} | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
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| 10111 | 17h | 0.40 x V _{CC} [reset] | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
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| 11111 | 1Fh | 0.5133 x V _{CC} | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| | | | | | | | | | | | <p>Note</p> <p>⁽¹⁾Pre-charge voltage level must be smaller than COM deselect voltage level</p> | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| 0 | BC | 1 | 0 | 1 | 1 | 1 | 1 | 0 | 0 | Individual Look Up Table for Gray Scale Pulse width (Color A) | The next 31 data bytes define Gray Scale (GS) Table by setting the gray scale pulse width in unit of DCLK's (ranges from 0d ~ 180d) for color A. | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| 1 | A1[7:0] | A1 ₇ | A1 ₆ | A1 ₅ | A1 ₄ | A1 ₃ | A1 ₂ | A1 ₁ | A1 ₀ | | | A1[7:0]: Gamma Setting for GS1A, | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| 1 | A2[7:0] | A2 ₇ | A2 ₆ | A2 ₅ | A2 ₄ | A2 ₃ | A2 ₂ | A2 ₁ | A2 ₀ | | | A2[7:0]: Gamma Setting for GS2A, | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| 1 | . | . | . | . | . | . | . | . | . | | | : | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| 1 | . | . | . | . | . | . | . | . | . | | | . | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| 1 | . | . | . | . | . | . | . | . | . | | | . | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| 1 | A30[7:0] | A30 ₇ | A30 ₆ | A30 ₅ | A30 ₄ | A30 ₃ | A30 ₂ | A30 ₁ | A30 ₀ | | | A30[7:0]: Gamma Setting for GS30A, | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| 1 | A31[7:0] | A31 ₇ | A31 ₆ | A31 ₅ | A31 ₄ | A31 ₃ | A31 ₂ | A31 ₁ | A31 ₀ | | | A31[7:0]: Gamma Setting for GS31A | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| | | | | | | | | | | | <p>Note</p> <p>⁽¹⁾ 0 ≤ Setting of GS1 < Setting of GS2 < Setting of GS3..... < Setting of GS30 < Setting of GS31</p> <p>⁽²⁾ GS0 does not has pre-charge and current drive stages.</p> <p>⁽³⁾ GS1 can be set as only pre-charge but no current drive stage by input gamma setting for GS1 equals 0.</p> <p>⁽⁴⁾ When command B8h is input, it selects one LUT for color A, B and C. i.e. GS1~31A, GS1~63B and GS1~31C are updated.</p> <p>⁽⁵⁾ Command B8h should be input before command BCh and BDh to select individual LUT for color B, A and C.</p> | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |

Fundamental Command Table

| D/C# | Hex | D7 | D6 | D5 | D4 | D3 | D2 | D1 | D0 | Command | Description | | | | | | | | | | | | | | | | | | |
|--------|----------|--------------------------------|------------------|------------------|------------------|------------------|------------------|------------------|------------------|---|--|-------------------------------|--|-------------------|-----|-----|------------------------|---|---|---|-----|-----|--------------------------------|---|---|---|-----|-----|------------------------|
| 0 | BD | 1 | 0 | 1 | 1 | 1 | 1 | 0 | 1 | Individual Look Up Table for Gray Scale Pulse width (Color C) | The next 31 data bytes define Gray Scale (GS) Table by setting the gray scale pulse width in unit of DCLK's (ranges from 0d ~ 180d) for color C. A1[7:0]: Gamma Setting for GS1C, A2[7:0]: Gamma Setting for GS2C, : A30[7:0]: Gamma Setting for GS30C, A31[7:0]: Gamma Setting for GS31C Note (1) $0 \leq \text{Setting of GS1} < \text{Setting of GS2} < \text{Setting of GS3} \dots < \text{Setting of GS30} < \text{Setting of GS31}$ (2) GS0 does not has pre-charge and current drive stages. (3) GS1 can be set as only pre-charge but no current drive stage by input gamma setting for GS1 equals 0. (4) When command B8h is input, it selects one LUT for color A, B and C. i.e. GS1~31A, GS1~63B and GS1~31C are updated. (5) Command B8h should be input before command BCh and BDh to select individual LUT for color B, A and C. | | | | | | | | | | | | | | | | | | |
| 1 | A1[7:0] | A1 ₇ | A1 ₆ | A1 ₅ | A1 ₄ | A1 ₃ | A1 ₂ | A1 ₁ | A1 ₀ | | | | | | | | | | | | | | | | | | | | |
| 1 | A2[7:0] | A2 ₇ | A2 ₆ | A2 ₅ | A2 ₄ | A2 ₃ | A2 ₂ | A2 ₁ | A2 ₀ | | | | | | | | | | | | | | | | | | | | |
| 1 | . | . | . | . | . | . | . | . | . | | | | | | | | | | | | | | | | | | | | |
| 1 | . | . | . | . | . | . | . | . | . | | | | | | | | | | | | | | | | | | | | |
| 1 | . | . | . | . | . | . | . | . | . | | | | | | | | | | | | | | | | | | | | |
| 1 | A30[7:0] | A30 ₇ | A30 ₆ | A30 ₅ | A30 ₄ | A30 ₃ | A30 ₂ | A30 ₁ | A30 ₀ | | | | | | | | | | | | | | | | | | | | |
| 1 | A31[7:0] | A31 ₇ | A31 ₆ | A31 ₅ | A31 ₄ | A31 ₃ | A31 ₂ | A31 ₁ | A31 ₀ | | | | | | | | | | | | | | | | | | | | |
| 0 | BE | 1 | 0 | 1 | 1 | 1 | 1 | 1 | 0 | | | Set V _{COMH} Voltage | Set COM deselect voltage level [reset = 05h] | | | | | | | | | | | | | | | | |
| 1 | A[2:0] | 0 | 0 | 0 | 0 | 0 | A ₂ | A ₁ | A ₀ | | | | | | | | | | | | | | | | | | | | |
| | | | | | | | | | | | <table border="1"> <thead> <tr> <th>A[2:0]</th> <th>Hex code</th> <th>V_{COMH}</th> </tr> </thead> <tbody> <tr> <td>000</td> <td>00h</td> <td>0.72 x V_{CC}</td> </tr> <tr> <td>:</td> <td>:</td> <td>:</td> </tr> <tr> <td>101</td> <td>05h</td> <td>0.82 x V_{CC} [reset]</td> </tr> <tr> <td>:</td> <td>:</td> <td>:</td> </tr> <tr> <td>111</td> <td>07h</td> <td>0.86 x V_{CC}</td> </tr> </tbody> </table> | A[2:0] | Hex code | V _{COMH} | 000 | 00h | 0.72 x V _{CC} | : | : | : | 101 | 05h | 0.82 x V _{CC} [reset] | : | : | : | 111 | 07h | 0.86 x V _{CC} |
| A[2:0] | Hex code | V _{COMH} | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| 000 | 00h | 0.72 x V _{CC} | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| : | : | : | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| 101 | 05h | 0.82 x V _{CC} [reset] | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| : | : | : | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| 111 | 07h | 0.86 x V _{CC} | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| 0 | C1 | 1 | 1 | 0 | 0 | 0 | 0 | 0 | 1 | Set Contrast Current for Color A,B,C | A[7:0] Contrast Value Color A [reset=7Fh] | | | | | | | | | | | | | | | | | | |
| 1 | A[7:0] | A ₇ | A ₆ | A ₅ | A ₄ | A ₃ | A ₂ | A ₁ | A ₀ | | B[7:0] Contrast Value Color B [reset=7Fh] | | | | | | | | | | | | | | | | | | |
| 1 | B[7:0] | B ₇ | B ₆ | B ₅ | B ₄ | B ₃ | B ₂ | B ₁ | B ₀ | | C[7:0] Contrast Value Color C [reset=7Fh] | | | | | | | | | | | | | | | | | | |
| 1 | C[7:0] | C ₇ | C ₆ | C ₅ | C ₄ | C ₃ | C ₂ | C ₁ | C ₀ | | | | | | | | | | | | | | | | | | | | |
| 0 | C7 | 1 | 1 | 0 | 0 | 0 | 1 | 1 | 1 | Master Contrast Current Control | A[3:0] : | | | | | | | | | | | | | | | | | | |
| 1 | A[3:0] | 0 | 0 | 0 | 0 | A ₃ | A ₂ | A ₁ | A ₀ | | 0000b reduce output currents for all colors to 1/16 0001b reduce output currents for all colors to 2/16 1110b reduce output currents for all colors to 15/16 1111b no change [reset] | | | | | | | | | | | | | | | | | | |
| 0 | CA | 1 | 1 | 0 | 0 | 1 | 0 | 1 | 0 | Set MUX Ratio | A[6:0] MUX ratio 4MUX ~ 176MUX, [reset=175] | | | | | | | | | | | | | | | | | | |
| 1 | A[7:0] | A ₇ | A ₆ | A ₅ | A ₄ | A ₃ | A ₂ | A ₁ | A ₀ | | (Ranges from 3 to 175) | | | | | | | | | | | | | | | | | | |
| 0 | E3 | 1 | 1 | 1 | 0 | 0 | 0 | 1 | 1 | NOP | Command for No Operation | | | | | | | | | | | | | | | | | | |

| Fundamental Command Table | | | | | | | | | | | |
|---------------------------|--------|----------------|----------------|----------------|----------------|----------------|----------------|----------------|----------------|------------------|--|
| D/C# | Hex | D7 | D6 | D5 | D4 | D3 | D2 | D1 | D0 | Command | Description |
| 0 | FD | 1 | 1 | 1 | 1 | 1 | 1 | 0 | 1 | | A[7:0]: MCU protection status [reset = 12h] |
| 1 | A[7:0] | A ₇ | A ₆ | A ₅ | A ₄ | A ₃ | A ₂ | A ₁ | A ₀ | Set Command Lock | A[7:0] = 12h, Unlock OLED driver IC MCU interface from entering command [reset] A[7:0] = 16h, Lock OLED driver IC MCU interface from entering command Note ⁽¹⁾ The locked OLED driver IC MCU interface prohibits all commands and memory access except the FDh command. |

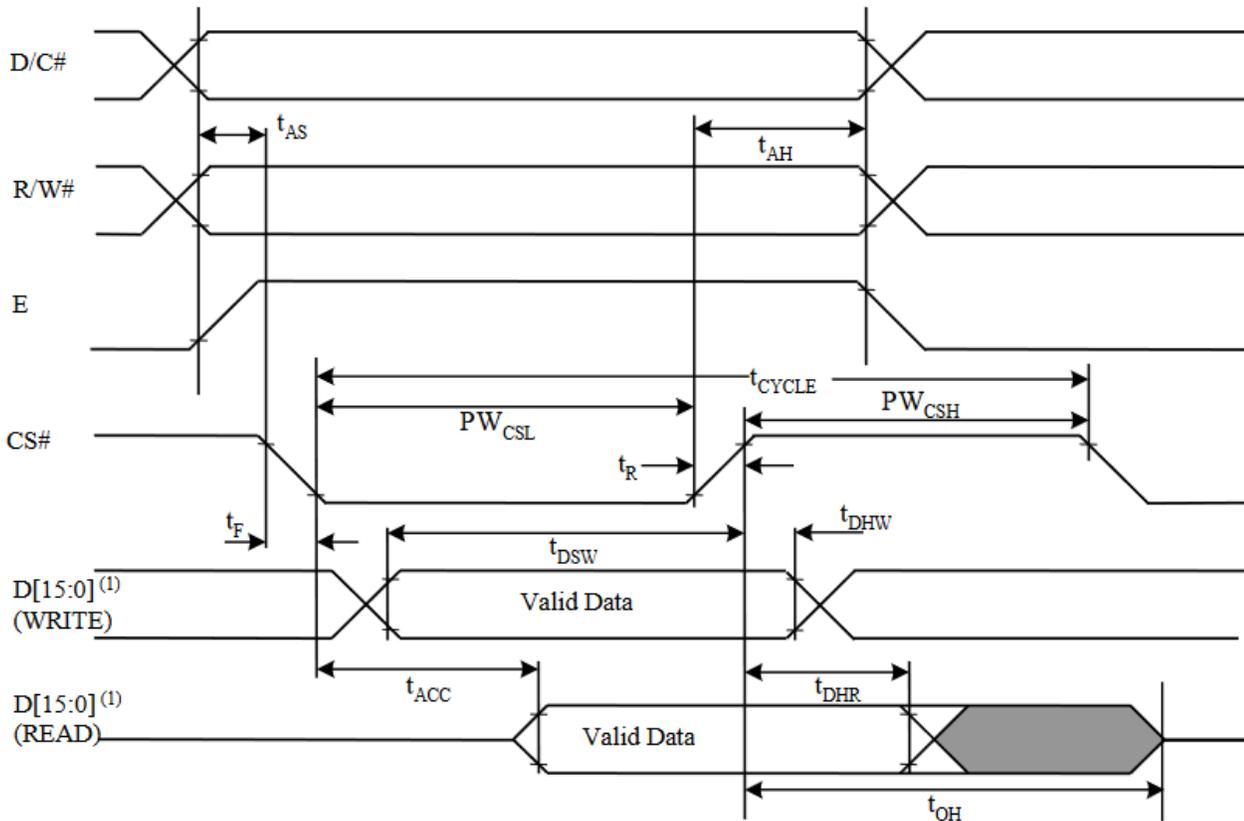
Note

⁽¹⁾ “*” stands for “Don’t care”.

Timing Characteristics

6800-Series MCU Parallel Interface:

| Symbol | Parameter | Min | Typ | Max | Unit |
|-------------|---|-----------|-----|-----|------|
| t_{CYCLE} | Clock Cycle Time (write) | 300 | - | - | ns |
| t_{AS} | Address Setup Time | 24 | - | - | ns |
| t_{AH} | Address Hold Time | 0 | - | - | ns |
| t_{DSW} | Write Data Setup Time | 40 | - | - | ns |
| t_{DHW} | Write Data Hold Time | 20 | - | - | ns |
| t_{DHR} | Read Data Hold Time | 20 | - | - | ns |
| t_{OH} | Output Disable Time | - | - | 70 | ns |
| t_{ACC} | Access Time | - | - | 180 | ns |
| PW_{CSL} | Chip Select Low Pulse Width (read) Chip Select Low Pulse Width (write) | 160 60 | - | - | ns |
| PW_{CSH} | Chip Select High Pulse Width (read) Chip Select High Pulse Width (write) | 60 60 | - | - | ns |
| t_R | Rise Time | - | - | 15 | ns |
| t_F | Fall Time | - | - | 15 | ns |

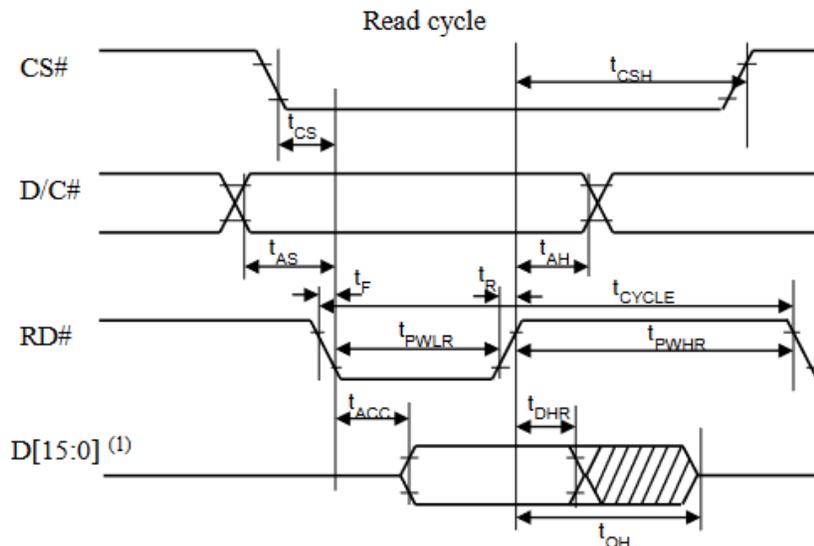
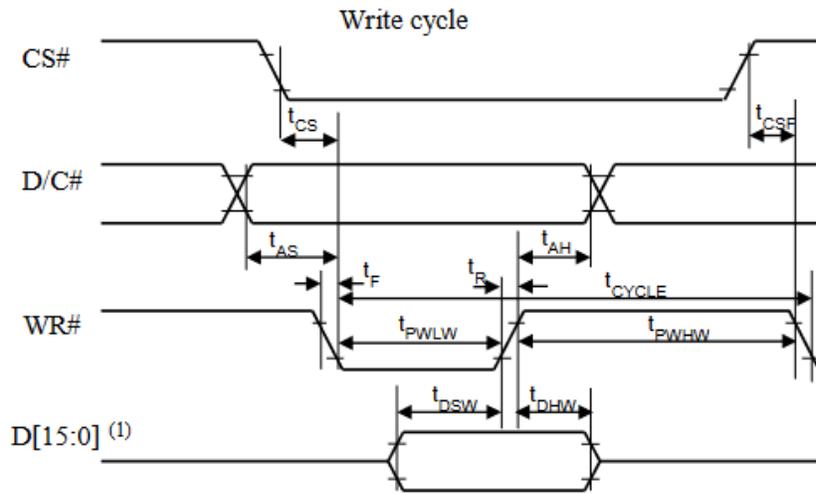


Note

⁽¹⁾ when 8 bit used: D[7:0] instead; when 16 bit used: D[15:0] instead.

8080-Series MCU Parallel Interface:

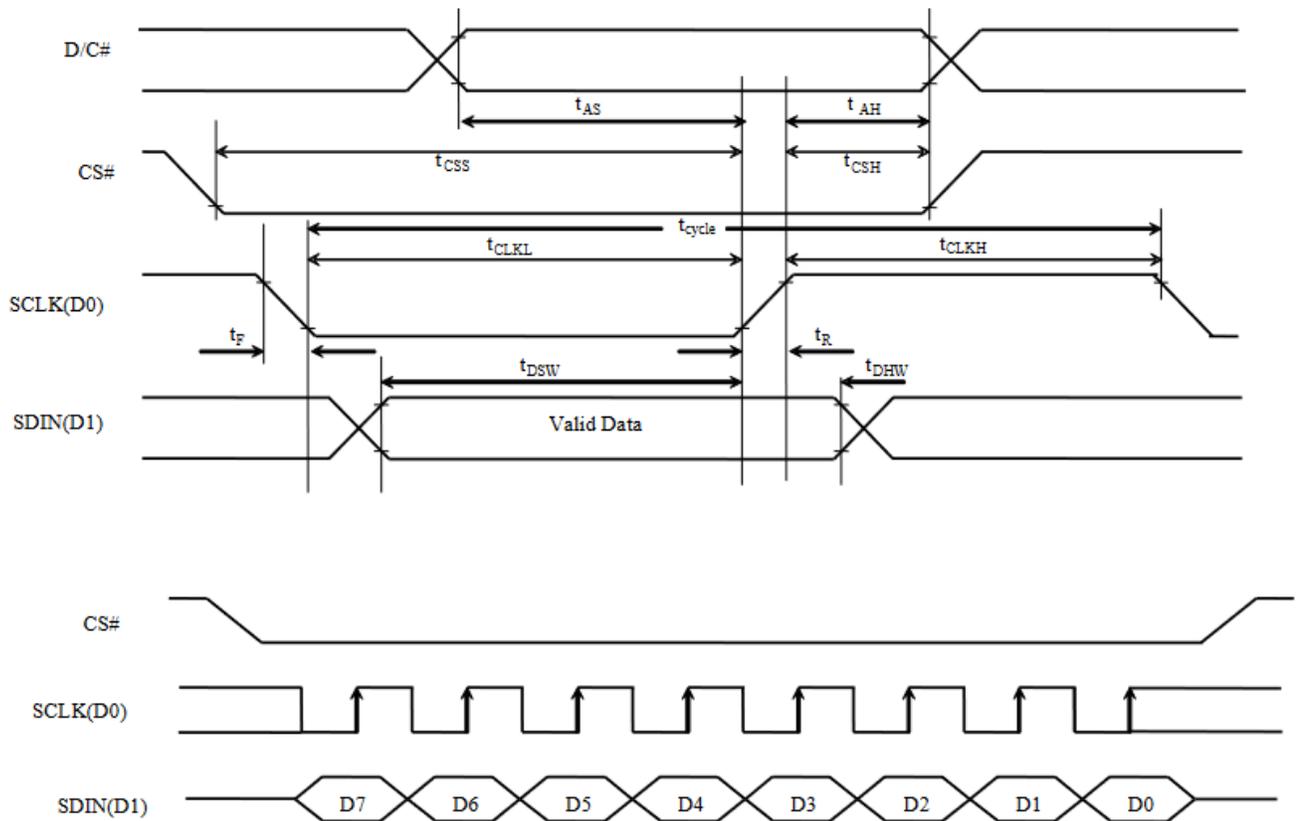
| Symbol | Parameter | Min | Typ | Max | Unit |
|-------------|--------------------------------------|-----|-----|-----|------|
| t_{CYCLE} | Clock Cycle Time (write) | 300 | - | - | ns |
| t_{AS} | Address Setup Time | 10 | - | - | ns |
| t_{AH} | Address Hold Time | 0 | - | - | ns |
| t_{DSW} | Write Data Setup Time | 40 | - | - | ns |
| t_{DHW} | Write Data Hold Time | 20 | - | - | ns |
| t_{DHR} | Read Data Hold Time | 20 | - | - | ns |
| t_{OH} | Output Disable Time | - | - | 46 | ns |
| t_{ACC} | Access Time | - | - | 180 | ns |
| t_{PWLW} | Read Low Time | 160 | - | - | ns |
| t_{PWLW} | Write Low Time | 60 | - | - | ns |
| t_{PWHW} | 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 |


Note

⁽¹⁾ when 8 bit used: D[7:0] instead; when 16 bit used: [15:0] instead.

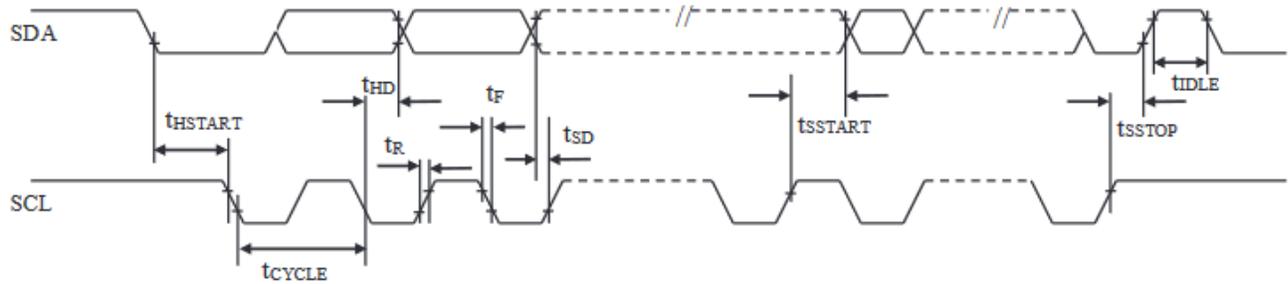
4-wire SPI:

| 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 | 42 | - | - | ns |
| t_{CSS} | Chip Select Setup Time | 20 | - | - | ns |
| t_{CSH} | Chip Select Hold Time | 20 | - | - | ns |
| t_{DSW} | Write Data Setup Time | 15 | - | - | ns |
| t_{DHW} | Write Data Hold Time | 25 | - | - | ns |
| t_{CLKL} | Clock Low Time | 30 | - | - | ns |
| t_{CLKH} | Clock High Time | 30 | - | - | ns |
| t_{R} | Rise Time | - | - | 15 | ns |
| t_{F} | Fall Time | - | - | 15 | ns |



I2C:

| Symbol | Parameter | Min | Typ | Max | Unit |
|---------------------|---|-----|-----|-----|------|
| t_{cycle} | Clock Cycle Time | 2.5 | - | - | us |
| t_{HSTART} | Start condition Hold Time | 0.6 | - | - | us |
| t_{HD} | Data Hold Time (for "SDA _{OUT} " pin) | 0 | - | - | ns |
| | Data Hold Time (for "SDA _{IN} " pin) | 300 | - | - | ns |
| t_{SD} | Data Setup Time | 100 | - | - | ns |
| t_{SSTART} | Start condition Setup Time (Only relevant for a repeated Start condition) | 0.6 | - | - | us |
| t_{SSTOP} | Stop condition Setup Time | 0.6 | - | - | us |
| t_{R} | Rise Time for data and clock pin | - | - | 300 | ns |
| t_{F} | Fall Time for data and clock pin | - | - | 300 | ns |
| t_{IDLE} | Idle Time before a new transmission can start | 1.3 | - | - | us |

Figure 9-5 : I²C interface Timing characteristics


Example Initialization Sequence

```

void Init_OLED(void)
{
    digitalWrite(P16,LOW);          //RES
    delay(10);
    digitalWrite(P16,HIGH);        //RES
    Set_Command_Lock(0x12);        // Unlock Driver IC
    Set_Display_On_Off(0xAE);      // Display Off
    Set_Remap_Format(0x64);        // Set Horizontal Address Increment
    Set_Start_Line(0x00);          // Set Mapping RAM Display Start Line
    Set_Display_Offset(0x00);      // Shift Mapping RAM Counter
    Set_Display_Mode(0xA6);        // Normal Display Mode
    Set_Phase_Length(0x24);
    Set_Display_Clock(0x80);
    Set_Precharge_Period(0x0F);    // Set Second Pre-Charge Period
    Set_Precharge_Voltage(0x1F);   // Set Pre-Charge Voltage Level as 0.40*VCC
    Set_VCOMH(0x05);              // Set Common Pins Deselect Voltage Level as
0.82*VCC
    Set_Contrast_Color(0x3C,0x39,0x43); // Set Contrast of Color A
    Set_Master_Current(0x0F);      // Set Scale Factor of Segment Output Current
Control
    Set_Multiplex_Ratio(0xAF);     // 1/128 Duty (Max_Row)
    command(0xB8);                //Gamma Look-Up Table
    data(0x00); //1
    data(0x02); //2
    data(0x04); //3
    data(0x06); //4
    data(0x07); //5
    data(0x08); //6
    data(0x09); //7
    data(0x0a); //8
    data(0x0b); //9
    data(0x0c); //10
    data(0x0d); //11
    data(0x0e); //12
    data(0x10); //13
    data(0x11); //14
    data(0x12); //15
    data(0x14); //16
    data(0x15); //17
    data(0x16); //18
    data(0x18); //19
    data(0x1a); //20
    data(0x1b); //21
    data(0x1d); //22
    data(0x1f); //23
    data(0x20); //24
    data(0x22); //25
    data(0x24); //26
    data(0x26); //27
    data(0x27); //28
    data(0x29); //29
    data(0x2b); //30
    data(0x2d); //31
    data(0x2f); //32
    data(0x31); //33
    data(0x33); //34
    data(0x35); //35
    data(0x37); //36
    data(0x39); //37

```

```
data(0x3b); //38
data(0x3d); //39
data(0x3f); //40
data(0x42); //41
data(0x44); //42
data(0x46); //43
data(0x48); //44
data(0x4b); //45
data(0x4d); //46
data(0x50); //47
data(0x52); //48
data(0x55); //49
data(0x57); //50
data(0x5a); //51
data(0x5b); //52
data(0x5f); //53
data(0x62); //54
data(0x65); //55
data(0x67); //56
data(0x6a); //57
data(0x6d); //58
data(0x70); //59
data(0x73); //60
data(0x76); //61
data(0x79); //62
data(0x7c); //63
Set_Display_On_Off(0xAF);           // Display On
}
```

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. | +70°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. | +65°C, 90% RH, 96hrs | 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-> 85°C,30min = 1 cycle 20 cycles | |
| Vibration test | Test the endurance of the display by applying vibration to simulate transportation and use. | 5-50Hz, 0.5G 2hrs in each of 3 directions X,Y,Z | 3 |
| Static electricity test | Test the endurance of the display by applying electric static discharge. | Air discharge ±8kV 10 times | |

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.