NEWHAVEN DISPLAY INTERNATIONAL

**Product Specification**

# NHD-C12832A1Z-FSR-FBW-3V3

## COG (Chip-On-Glass) Liquid Crystal Display Module

| | |
|---|---|
| **NHD-** | Newhaven Display |
| **C12832-** | 128 x 32 Pixels |
| **A1Z-** | Model |
| **F-** | Transflective |
| **SR-** | Red LED Edge Backlight |
| **F-** | FSTN (+) |
| **B-** | 6:00 Optimal View |
| **W-** | Wide Temperature |
| **3V3-** | 3Vdd, 3V Backlight |

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REACH Compliant

RoHS Compliant

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# Table of Contents



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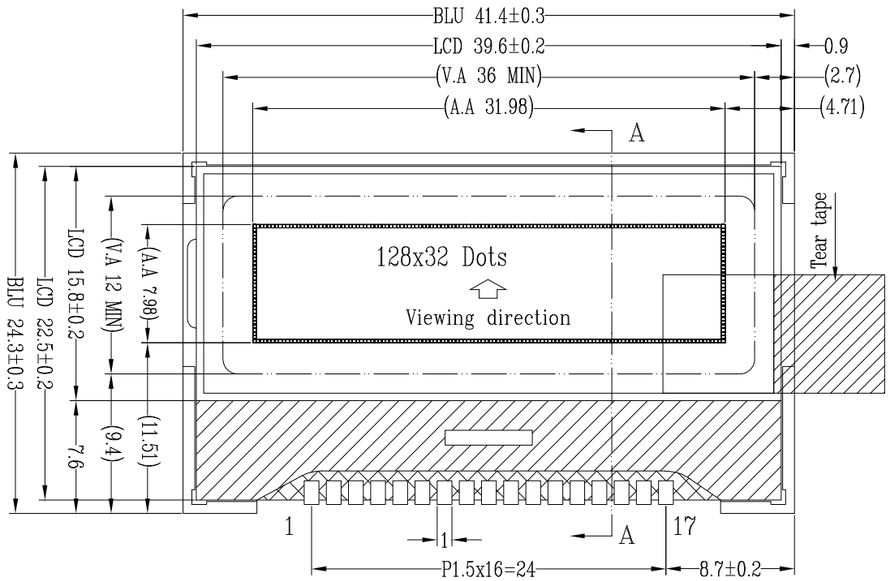
## Additional Resources

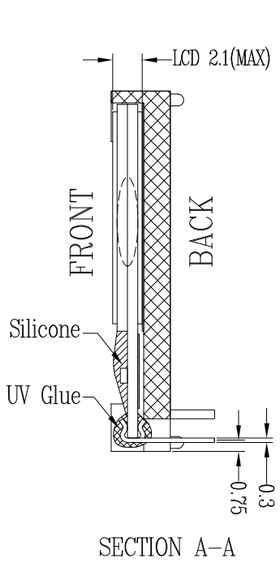
- **Support Forum:** https://support.newhavendisplay.com/hc/en-us/community/topics
- **GitHub:** https://github.com/newhavendisplay
- **Example Code:** https://support.newhavendisplay.com/hc/en-us/categories/4409527834135-Example-Code/
- **Knowledge Center:** https://www.newhavendisplay.com/knowledge_center.html
- **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

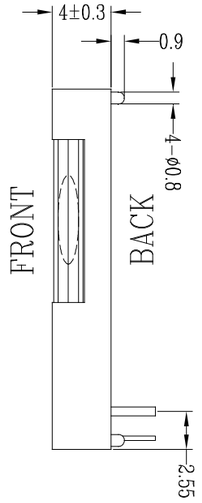
| Revision | Date | Description | Changed By |
|---|---|---|---|
| 0 | 11/12/2008 | Initial Release | - |
| 1 | 09/27/2010 | User Guide Reformat | BE |
| 2 | 05/06/2013 | Electrical and Optical characteristics updated. Pin Description, Wiring Diagram, Mechanical Drawing Page and Example Initialization Program Updated. | JN |
| 3 | 01/24/2017 | Mechanical Drawing, Electrical & Optical Char. Updated | SB |
| 4 | 07/05/2019 | Added PCB Footprint Drawing | AS |
| 5 | 01/30/2020 | Glass Panel Updated | SB |
| 6 | 06/17/2020 | Updated 2D Mechanical Drawing & Quality Information | AS |
| 7 | 04/14/2024 | PCB Footprint Drawing Updated | KL |

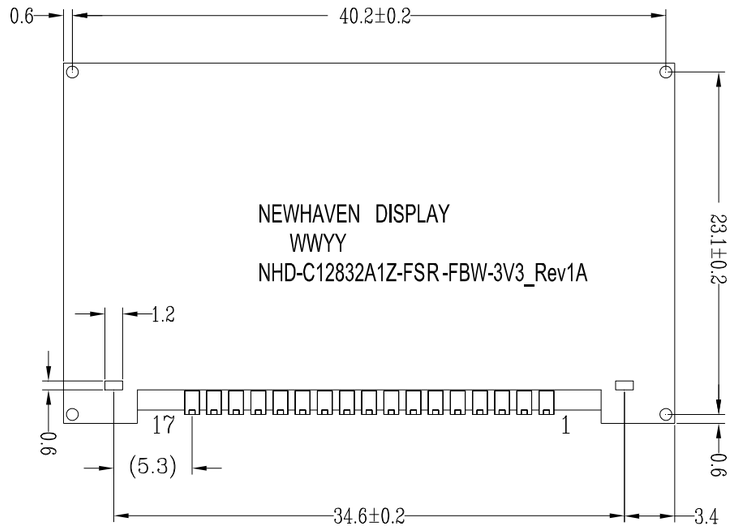
# Mechanical Drawing

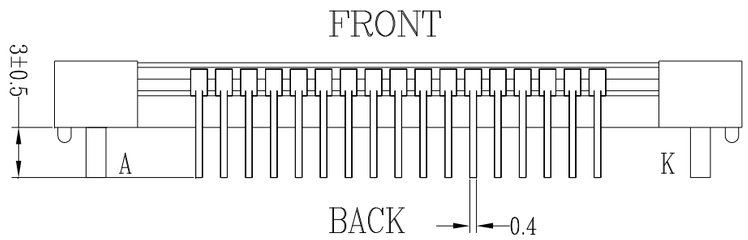



SECTION A–A

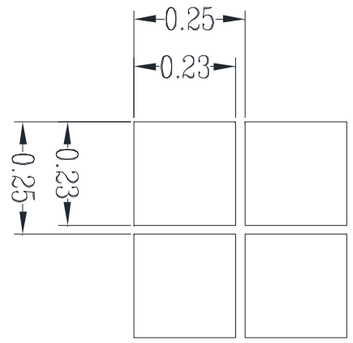




COM & SEG Layout




| NO. | Symbol |
|---|---|
| 1 | V0 |
| 2 | V1 |
| 3 | V2 |
| 4 | V3 |
| 5 | V4 |
| 6 | C2- |
| 7 | C2+ |
| 8 | C1+ |
| 9 | C1- |
| 10 | VOUT |
| 11 | VSS |
| 12 | VDD |
| 13 | SI |
| 14 | SCL |
| 15 | A0 |
| 16 | /RES |
| 17 | CS1B |

Product Description: 128x32 Graphic COG LCD

1. Driver IC: ST7565R
2. Driving Mode: 1/33 Duty, 1/6 Bias
3. Interface: 4-Wire SPI
4. Power Requirement: 3.0V LCD
5. Optical Features: FSTN (+), Transflective, 6:00 View, Red Backlight

**Standard Tolerance:**
(Unless otherwise specified)
Linear: ±0.3mm

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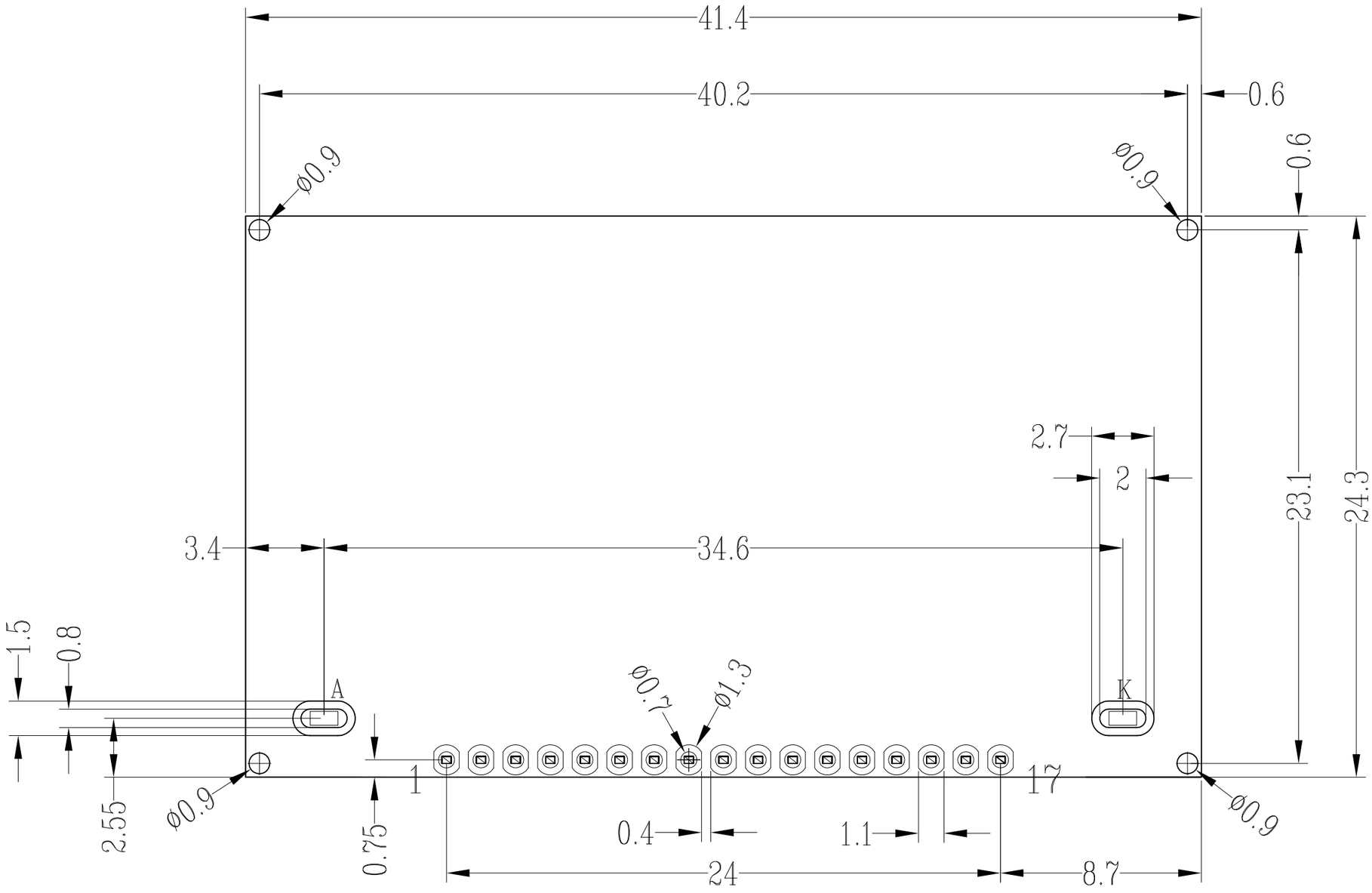
Drawing/Part Number: NHD-C12832A1Z-FSR-FBW-3V3
Revision: 1A

**Unless otherwise specified:**
• Dimensions are in Millimeters
• Third Angle Projection

Drawn By: K. Lewis
Approved By: K. Lewis
Drawn Date: 04/14/2024
Approved Date: 04/14/2024

# Mechanical Drawing

Recommended PCB Footprint




**Applicable Displays:**

1) NHD-C12832A1Z-FSW-FBW-3V3
2) NHD-C12832A1Z-NSW-BBW-3V3
3) NHD-C12832A1Z-FSR-FBW-3V3
4) NHD-C12832A1Z-FSB-FBW-3V3

**Standard Tolerance:**
(Unless otherwise specified)
Linear: ±0.3mm

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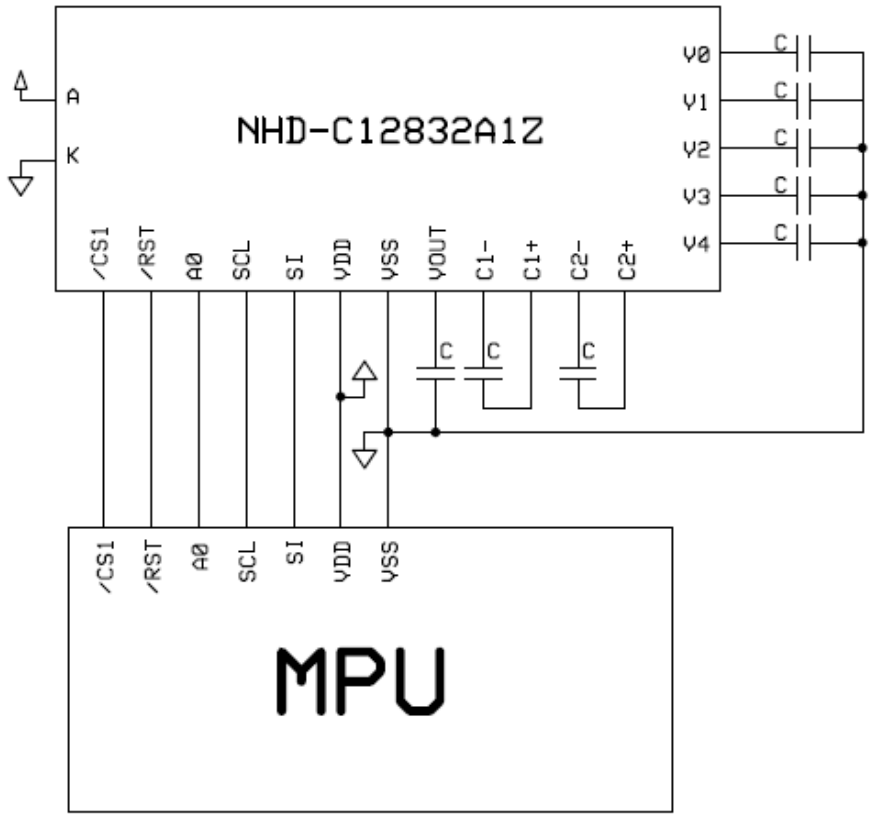
| | | |
|---|---|---|
| Drawing/Part Number: NHD-C12832A1Z-Monochrome-Footprint | | Revision: - |
| **Unless otherwise specified:** • Dimensions are in Millimeters • Third Angle Projection | Drawn By: K. Lewis | Approved By: K. Lewis |
| | Drawn Date: 04/09/2024 | Approved Date: 04/09/2024 |

# Pin Description

| Pin No. | Symbol | External Connection | Function Description |
|---|---|---|---|
| 1 | $V_0$ | Power Supply | 0.1µF – 1µF Capacitor to $V_{SS}$ |
| 2 | $V_1$ | Power Supply | 0.1µF – 1µF Capacitor to $V_{SS}$ |
| 3 | $V_2$ | Power Supply | 0.1µF – 1µF Capacitor to $V_{SS}$ |
| 4 | $V_3$ | Power Supply | 0.1µF – 1µF Capacitor to $V_{SS}$ |
| 5 | $V_4$ | Power Supply | 0.1µF – 1µF Capacitor to $V_{SS}$ |
| 6 | C2- | Power Supply | Connect 1µF – 2.2µF Capacitor to C2+ (pin 7) |
| 7 | C2+ | Power Supply | Connect 1µF – 2.2µF Capacitor to C2- (pin 6) |
| 8 | C1+ | Power Supply | Connect 1µF – 2.2µF Capacitor to C1- (pin 9) |
| 9 | C1- | Power Supply | Connect 1µF – 2.2µF Capacitor to C1+ (pin 8) |
| 10 | $V_{OUT}$ | Power Supply | Connect 1µF – 2.2µF Capacitor to VSS (pin 11) |
| 11 | $V_{SS}$ | Power Supply | Ground |
| 12 | $V_{DD}$ | Power Supply | Supply Voltage for LCD and Logic (+3V) |
| 13 | SI | MPU | Serial Data |
| 14 | SCL | MPU | Serial Clock |
| 15 | A0 | MPU | Register Select. A0=0: Instruction; A0=1: Data |
| 16 | /RST | MPU | Active LOW Reset signal |
| 17 | /CS1 | MPU | Active LOW Chip Select signal |
| A | LED+ | Power Supply | Backlight Anode (+3V) |
| K | LED- | Power Supply | Backlight Cathode (Ground) |

**Recommended LCD connector:** 1.5mm pitch pins, solder directly into PCB
**Backlight connector:** 1.2mm Wide pins, solder directly into PCB **Mates with**: ---
**Recommended Breakout Board:** NHD-PCB12832A1Z

# Wiring Diagram



# Electrical Characteristics

| Item | Symbol | Condition | Min. | Typ. | Max. | Unit |
|---|---|---|---|---|---|---|
| Operating Temperature Range | $T_{OP}$ | Absolute Max | -20 | - | +70 | °C |
| Storage Temperature Range | $T_{ST}$ | Absolute Max | -30 | - | +80 | °C |
| Supply Voltage | | - | 2.7 | 3.0 | 3.3 | V |
| Supply Current | $I_{DD}$ | $V_{DD}$ =3.0V | 0.1 | 0.4 | 1.0 | mA |
| Supply for LCD (contrast) | $V_{LCD}$ | $T_{OP}$ = 25°C | 5.8 | 6.0 | 6.2 | V |
| "H" Level input | $V_{IH}$ | - | 0.8 *$V_{DD}$ | - | $V_{DD}$ | V |
| "L" Level input | $V_{IL}$ | - | $V_{SS}$ | - | 0.2 * $V_{DD}$ | V |
| "H" Level output | $V_{OH}$ | - | 0.8 * $V_{DD}$ | - | $V_{DD}$ | V |
| "L" Level output | $V_{OL}$ | - | $V_{SS}$ | - | 0.2 * $V_{DD}$ | V |
| | | | | | | |
| Backlight supply voltage | $V_{LED}$ | - | 2.9 | 3.0 | 3.1 | V |
| Backlight supply current | $I_{LED}$ | $V_{LED}$=3.0V | 10 | 20 | 26 | mA |

# Optical Characteristics

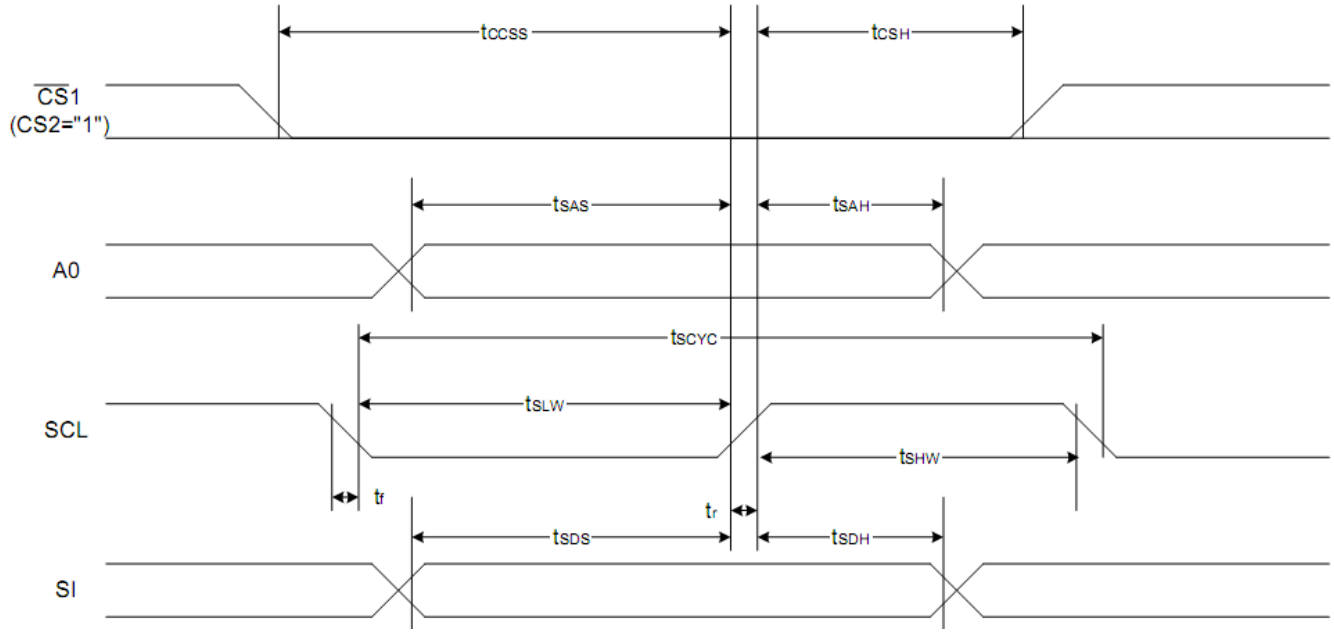
| Item | | Symbol | Condition | Min. | Typ. | Max. | Unit |
|---|---|---|---|---|---|---|---|
| Optimal Viewing Angles | Top | φY+ | CR ≥ 2 | - | 20 | - | º |
| | Bottom | φY- | | - | 40 | - | º |
| | Left | θX- | | - | 40 | - | º |
| | Right | θX+ | | - | 40 | - | º |
| Contrast Ratio | | CR | - | 2 | 8 | - | - |
| Response Time | Rise | $T_R$ | $T_{OP}$ = 25°C | - | 200 | 250 | ms |
| | Fall | $T_F$ | | - | 250 | 320 | ms |

# Controller Information

Built-in ST7565R Controller: https://support.newhavendisplay.com/hc/en-us/articles/4414899357591-ST7565R

# Timing Characteristics

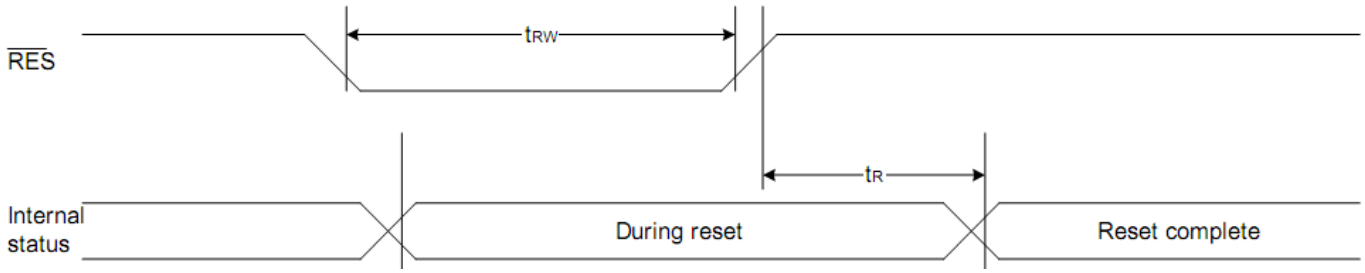
**The 4-line SPI Interface**




| Item | Signal | Symbol | Condition | Rating | | Units |
|---|---|---|---|---|---|---|
| | | | | Min. | Max. | |
| 4-line SPI Clock Period | SCL | Tscyc | | 50 | — | ns |
| SCL "H" pulse width | | Tshw | | 25 | — | |
| SCL "L" pulse width | | TSLW | | 25 | — | |
| Address setup time | A0 | TSAS | | 20 | — | |
| Address hold time | | Tsah | | 10 | — | |
| Data setup time | SI | Tsds | | 20 | — | |
| Data hold time | | TSDH | | 10 | — | |
| CS-SCL time | CS | Tcss | | 20 | — | |
| CS-SCL time | | Tcsh | | 40 | — | |

*1 The input signal rise and fall time (tr, tf) are specified at 15 ns or less.
*2 All timing is specified using 20% and 80% of VDD as the standard.

**Reset Timing**



# Table of Commands

| Command | Command Code | | | | | | | | | | | Function |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | A0 | /RD | /WR | D7 | D6 | D5 | D4 | D3 | D2 | D1 | D0 | |
| (1) Display ON/OFF | 0 | 1 | 0 | 1 | 0 | 1 | 0 | 1 | 1 | 1 | 0<br>1 | LCD display ON/OFF<br>0: OFF, 1: ON |
| (2) Display start line set | 0 | 1 | 0 | 0 | 1 | Display start address | | | | | | Sets the display RAM display start line address |
| (3) Page address set | 0 | 1 | 0 | 1 | 0 | 1 | 1 | Page address | | | | Sets the display RAM page address |
| (4) Column address set upper bit<br>Column address set lower bit | 0 | 1 | 0 | 0 | 0 | 0 | 1 | Most significant column address | | | | Sets the most significant 4 bits of the display RAM column address.<br>Sets the least significant 4 bits of the display RAM column address. |
| | | | | 0 | 0 | 0 | 0 | Least significant column address | | | | |
| (5) Status read | 0 | 0 | 1 | Status | | | | 0 | 0 | 0 | 0 | Reads the status data |
| (6) Display data write | 1 | 1 | 0 | Write data | | | | | | | | Writes to the display RAM |
| (7) Display data read | 1 | 0 | 1 | Read data | | | | | | | | Reads from the display RAM |
| (8) ADC select | 0 | 1 | 0 | 1 | 0 | 1 | 0 | 0 | 0 | 0 | 0<br>1 | Sets the display RAM address SEG output correspondence<br>0: normal, 1: reverse |
| (9) Display normal/ reverse | 0 | 1 | 0 | 1 | 0 | 1 | 0 | 0 | 1 | 1 | 0<br>1 | Sets the LCD display normal/ reverse<br>0: normal, 1: reverse |
| (10) Display all points ON/OFF | 0 | 1 | 0 | 1 | 0 | 1 | 0 | 0 | 1 | 0 | 0<br>1 | Display all points<br>0: normal display<br>1: all points ON |
| (11) LCD bias set | 0 | 1 | 0 | 1 | 0 | 1 | 0 | 0 | 0 | 1 | 0<br>1 | Sets the LCD drive voltage bias ratio<br>0: 1/9 bias, 1: 1/7 bias (ST7565R) |
| (12) Read-modify-write | 0 | 1 | 0 | 1 | 1 | 1 | 0 | 0 | 0 | 0 | 0 | Column address increment<br>At write: +1<br>At read: 0 |
| (13) End | 0 | 1 | 0 | 1 | 1 | 1 | 0 | 1 | 1 | 1 | 0 | Clear read/modify/write |
| (14) Reset | 0 | 1 | 0 | 1 | 1 | 1 | 0 | 0 | 0 | 1 | 0 | Internal reset |
| (15) Common output mode select | 0 | 1 | 0 | 1 | 1 | 0 | 0 | 0<br>1 | * | * | * | Select COM output scan direction<br>0: normal direction<br>1: reverse direction |
| (16) Power control set | 0 | 1 | 0 | 0 | 0 | 1 | 0 | 1 | Operating mode | | | Select internal power supply operating mode |
| (17) $V_0$ voltage regulator internal resistor ratio set | 0 | 1 | 0 | 0 | 0 | 1 | 0 | 0 | Resistor ratio | | | Select internal resistor ratio(Rb/Ra) mode |
| (18) Electronic volume mode set<br>Electronic volume register set | 0 | 1 | 0 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | Set the $V_0$ output voltage electronic volume register |
| | | | | 0 | 0 | Electronic volume value | | | | | | |
| (19) Sleep mode set | 0 | 1 | 0 | 1 | 0 | 1 | 0 | 1 | 1 | 0 | 0<br>1 | 0: Sleep mode, 1: Normal mode |
| | | | | * | * | * | * | * | * | 0 | 0 | |
| (20) Booster ratio set | 0 | 1 | 0 | 1 | 1 | 1 | 1 | 1 | 0 | 0 | 0 | select booster ratio<br>00: 2x,3x,4x<br>01: 5x<br>11: 6x |
| | | | | 0 | 0 | 0 | 0 | 0 | 0 | step-up value | | |
| (21) NOP | 0 | 1 | 0 | 1 | 1 | 1 | 0 | 0 | 0 | 1 | 1 | Command for non-operation |
| (22) Test | 0 | 1 | 0 | 1 | 1 | 1 | 1 | * | * | * | * | Command for IC test. Do not use this command |

# Example Initialization Program

```
 void data_out(unsigned char i) //Data Output Serial Interface
{
            unsigned int n;
            CS = 0;
            A0 = 1;
            for(n=0; n<8; n++){
   i <<=1;
            SCL = 0;
            P1  = i;
            delay(2);
            SCL = 1;
            }
            CS = 1;
}
void comm_out(unsigned char j) //Command Output Serial Interface
{
            unsigned int n;
            CS = 0;
            A0  = 0;
            for(n=0; n<8; n++){
   j <<=1;
            SCL = 0;
            P1  = j;
            delay(2);
            SCL = 1;
            }
            CS = 1;
}

/*****************************************************
*         Initialization For controller          *
*****************************************************/
void init_LCD()
{
comm_out(0xA0);
comm_out(0xAE);
comm_out(0xC0);
comm_out(0xA2);
comm_out(0x2F);
comm_out(0x21);
comm_out(0x81);
comm_out(0x3F);
}
/*****************************************************/
```

# Quality Information

| Test Item | Content of Test | Test Condition | Note |
|---|---|---|---|
| High Temperature storage | Endurance test applying the high storage temperature for a long time. | +80°C, 96hrs | 2 |
| Low Temperature storage | Endurance test applying the low storage temperature for a long time. | -30°C, 96hrs | 1,2 |
| High Temperature Operation | Endurance test applying the electric stress (voltage & current) and the high thermal stress for a long time. | +70°C, 96hrs | 2 |
| Low Temperature Operation | Endurance test applying the electric stress (voltage & current) and the low thermal stress for a long time. | -20°C, 96hrs | 1,2 |
| High Temperature / Humidity Operation | Endurance test applying the electric stress (voltage & current) and the high thermal with high humidity stress for a long time. | +40°C, 90% RH, 96hrs | 1,2 |
| Thermal Shock resistance | Endurance test applying the electric stress (voltage & current) during a cycle of low and high thermal stress. | -20°C, 30min -> 70°C, 60min<br>= 1 cycle<br>For 20 cycles | |
| Vibration test | Endurance test applying vibration to simulate transportation and use. | 10-50Hz, 5G amplitude.<br>30min in each of 3 directions X, Y, Z | 3 |
| Static electricity test | Endurance test applying electric static discharge. | Air: ±8kV 150pF/330Ω, 5 Times<br>Contact: ±4kV 150pF/330Ω, 5 Times | |

**Note 1:** No condensation to be observed.
**Note 2:** Conducted after 4 hours of storage at 25°C, 0%RH.
**Note 3:** Test performed on product itself, not inside a container.