



# THE DATASHEET OF NHD-C12832A1Z-FSW-FBW-3V3

## Product Specification

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# NHD-C12832A1Z-FSW-FBW-3V3

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

|                |                          |
|----------------|--------------------------|
| <b>NHD-</b>    | Newhaven Display         |
| <b>C12832-</b> | 128 x 32 Pixels          |
| <b>A1Z-</b>    | Model                    |
| <b>F-</b>      | Transflective            |
| <b>SW-</b>     | Side white LED Backlight |
| <b>F-</b>      | FSTN (+)                 |
| <b>B-</b>      | 6:00 Optimal View        |
| <b>W-</b>      | Wide Temperature         |
| <b>3V3-</b>    | 3.0V LCD, 3.0V Backlight |

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## Additional Resources

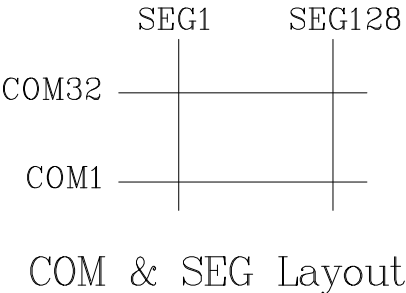
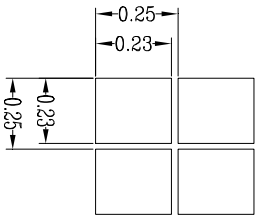
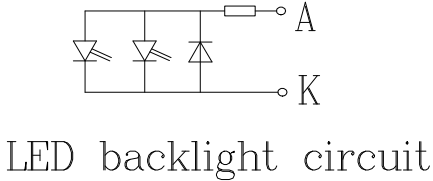
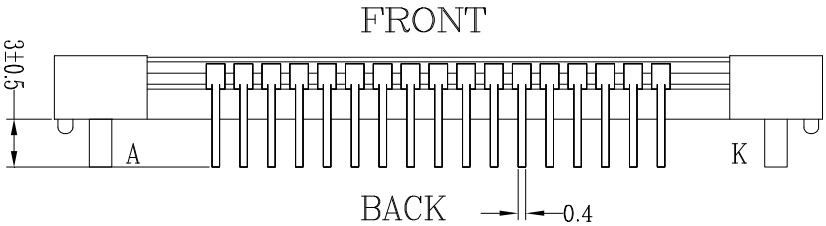
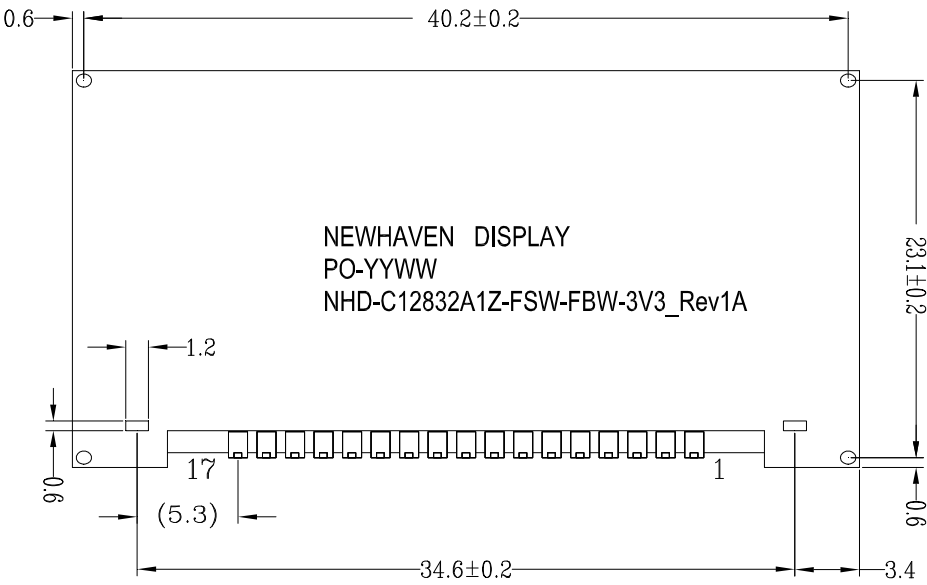
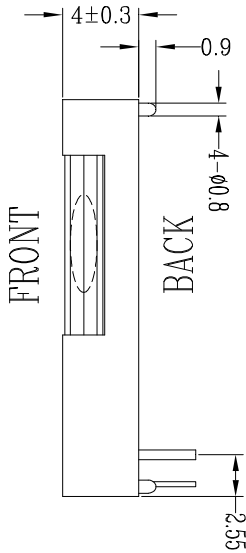
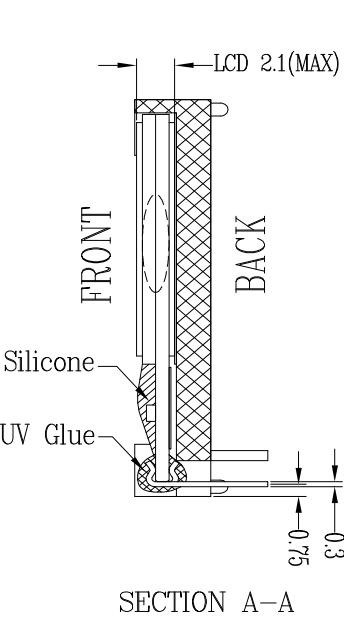
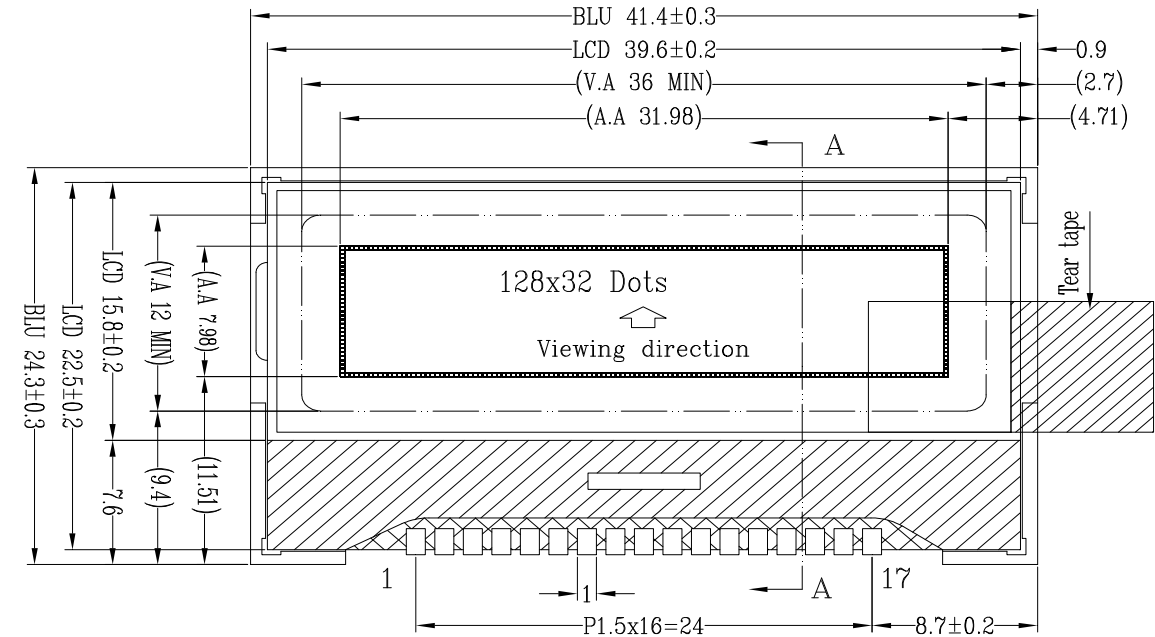
- **Support Forum:** <https://support.newhavendisplay.com/hc/en-us/community/topics>
- **GitHub:** <https://github.com/newhavendisplay>
- **Example Code:** <https://support.newhavendisplay.com/hc/en-us/categories/4409527834135-Example-Code/>
- **Knowledge Center:** [https://www.newhavendisplay.com/knowledge\\_center.html](https://www.newhavendisplay.com/knowledge_center.html)
- **Quality Center:** [https://www.newhavendisplay.com/quality\\_center.html](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        | 08/24/2009 | User Guide Reformat                                                                                                                                  | BE         |
| 2        | 10/13/2009 | Updated Electric Characteristic                                                                                                                      | MC         |
| 3        | 05/06/2013 | Electrical and Optical Characteristics updated. Pin Description, Wiring Diagram, Mechanical Drawing Page and Example Initialization Program Updated. | JN         |
| 4        | 01/23/2017 | Mechanical Drawing, Electrical & Optical Char. Updated                                                                                               | SB         |
| 5        | 07/05/2019 | Added PCB Footprint Drawing                                                                                                                          | AS         |
| 6        | 01/30/2020 | Glass Panel Updated                                                                                                                                  | SB         |
| 7        | 06/17/2020 | Updated 2D Mechanical Drawing, Footprint Drawing for Correct Display & Quality Information                                                           | AS         |
| 8        | 08/23/2023 | Date Code Format Updated on Mechanical Drawing                                                                                                       | KL         |
| 9        | 04/14/2024 | PCB Footprint Drawing Updated                                                                                                                        | KL         |

Mechanical Drawing



| 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  | AO     |
| 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, White Backlight

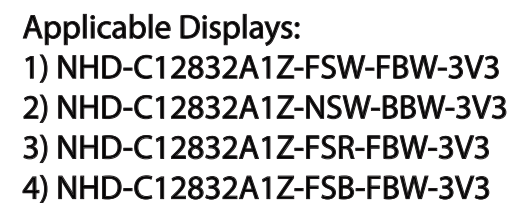
**Standard Tolerance:**  
(Unless otherwise specified)

Linear: ±0.3mm

**NEWHAVEN DISPLAY**  
INTERNATIONAL

|                                                                                                                                                                                                                       |                                                            |                                                                  |
|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------------------------------------------------|------------------------------------------------------------------|
| Drawing/Part Number:<br><b>NHD-C12832A1Z-FSW-FBW-3V3</b>                                                                                                                                                              |                                                            | Revision:<br><b>1A</b>                                           |
| Unless otherwise specified:<br>• Dimensions are in Millimeters<br>• Third Angle Projection                                                                                                                            | Drawn By: <b>K. Lewis</b><br>Drawn Date: <b>08/23/2023</b> | Approved By: <b>K. Lewis</b><br>Approved Date: <b>08/23/2023</b> |
| 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. |                                                            |                                                                  |

## Recommended PCB Footprint



|                                                                                                                                                                                                                                              |                                                                                                                                |                           |
|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------|---------------------------|
| <b>Standard Tolerance:</b><br>(Unless otherwise specified)<br><br>Linear: $\pm 0.3\text{mm}$                                                                                                                                                 |  <b>NEWHAVEN DISPLAY</b><br>INTERNATIONAL |                           |
|                                                                                                                                                                                                                                              | Drawing/Part Number:<br><b>NHD-C12832A1Z-Monochrome-Footprint</b>                                                              | Revision:<br>-            |
| <b>Unless otherwise specified:</b> <ul style="list-style-type: none"> <li>• Dimensions are in Millimeters</li> <li>• Third Angle Projection </li> </ul> | Drawn By: K. Lewis                                                                                                             | Approved By: K. Lewis     |
|                                                                                                                                                                                                                                              | Drawn Date: 04/09/2024                                                                                                         | Approved Date: 04/09/2024 |
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## Pin Description

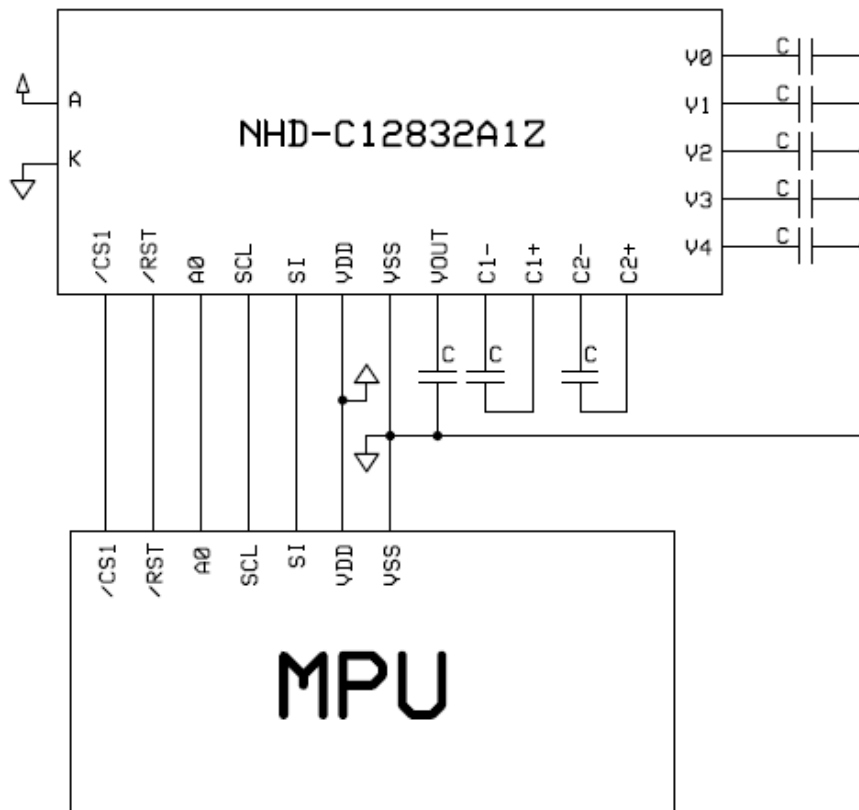
| Pin No. | Symbol           | External Connection | Function Description                                      |
|---------|------------------|---------------------|-----------------------------------------------------------|
| 1       | V <sub>0</sub>   | Power Supply        | 0.1μF – 1μF Capacitor to V <sub>SS</sub>                  |
| 2       | V <sub>1</sub>   | Power Supply        | 0.1μF – 1μF Capacitor to V <sub>SS</sub>                  |
| 3       | V <sub>2</sub>   | Power Supply        | 0.1μF – 1μF Capacitor to V <sub>SS</sub>                  |
| 4       | V <sub>3</sub>   | Power Supply        | 0.1μF – 1μF Capacitor to V <sub>SS</sub>                  |
| 5       | V <sub>4</sub>   | Power Supply        | 0.1μF – 1μF Capacitor to V <sub>SS</sub>                  |
| 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 <sub>OUT</sub> | Power Supply        | Connect 1μF – 2.2μF Capacitor to V <sub>SS</sub> (pin 11) |
| 11      | V <sub>SS</sub>  | Power Supply        | Ground                                                    |
| 12      | V <sub>DD</sub>  | 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 <sub>OP</sub>  | Absolute Max                                      | -20                   | -    | +70                   | °C   |
| Storage Temperature Range   | T <sub>ST</sub>  | Absolute Max                                      | -30                   | -    | +80                   | °C   |
| Supply Voltage              | V <sub>DD</sub>  | -                                                 | 2.7                   | 3.0  | 3.3                   | V    |
| Supply Current              | I <sub>DD</sub>  | T <sub>OP</sub> = 25°C,<br>V <sub>DD</sub> = 3.0V | 0.1                   | 0.4  | 1                     | mA   |
| Supply for LCD (contrast)   | V <sub>LCD</sub> | T <sub>OP</sub> = 25°C                            | 5.8                   | 6.0  | 6.2                   | V    |
| "H" Level input             | V <sub>IH</sub>  | -                                                 | 0.8 * V <sub>DD</sub> | -    | V <sub>DD</sub>       | V    |
| "L" Level input             | V <sub>IL</sub>  | -                                                 | V <sub>SS</sub>       | -    | 0.2 * V <sub>DD</sub> | V    |
| "H" Level output            | V <sub>OH</sub>  | -                                                 | 0.8 * V <sub>DD</sub> | -    | V <sub>DD</sub>       | V    |
| "L" Level output            | V <sub>OL</sub>  | -                                                 | V <sub>SS</sub>       | -    | 0.2 * V <sub>DD</sub> | V    |
|                             |                  |                                                   |                       |      |                       |      |
| Backlight supply voltage    | V <sub>LED</sub> | -                                                 | 2.9                   | 3.0  | 3.1                   | V    |
| Backlight supply current    | I <sub>LED</sub> | V <sub>LED</sub> = 3.0V                           | 10                    | 30   | 36                    | mA   |

## Optical Characteristics

| Item                   |        | Symbol         | Condition              | Min. | Typ. | Max. | Unit |
|------------------------|--------|----------------|------------------------|------|------|------|------|
| Optimal Viewing Angles | Top    | φY+            | CR ≥ 2                 | -    | 20   | -    | °    |
|                        | Bottom | φY-            |                        | -    | 40   | -    | °    |
|                        | Left   | θX-            |                        | -    | 40   | -    | °    |
|                        | Right  | θX+            |                        | -    | 40   | -    | °    |
| Contrast Ratio         |        | CR             | -                      | 2    | 8    | -    | -    |
| Response Time          | Rise   | T <sub>R</sub> | T <sub>OP</sub> = 25°C | -    | 200  | 250  | ms   |
|                        | Fall   | T <sub>F</sub> |                        | -    | 250  | 320  | ms   |

## Controller Information

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

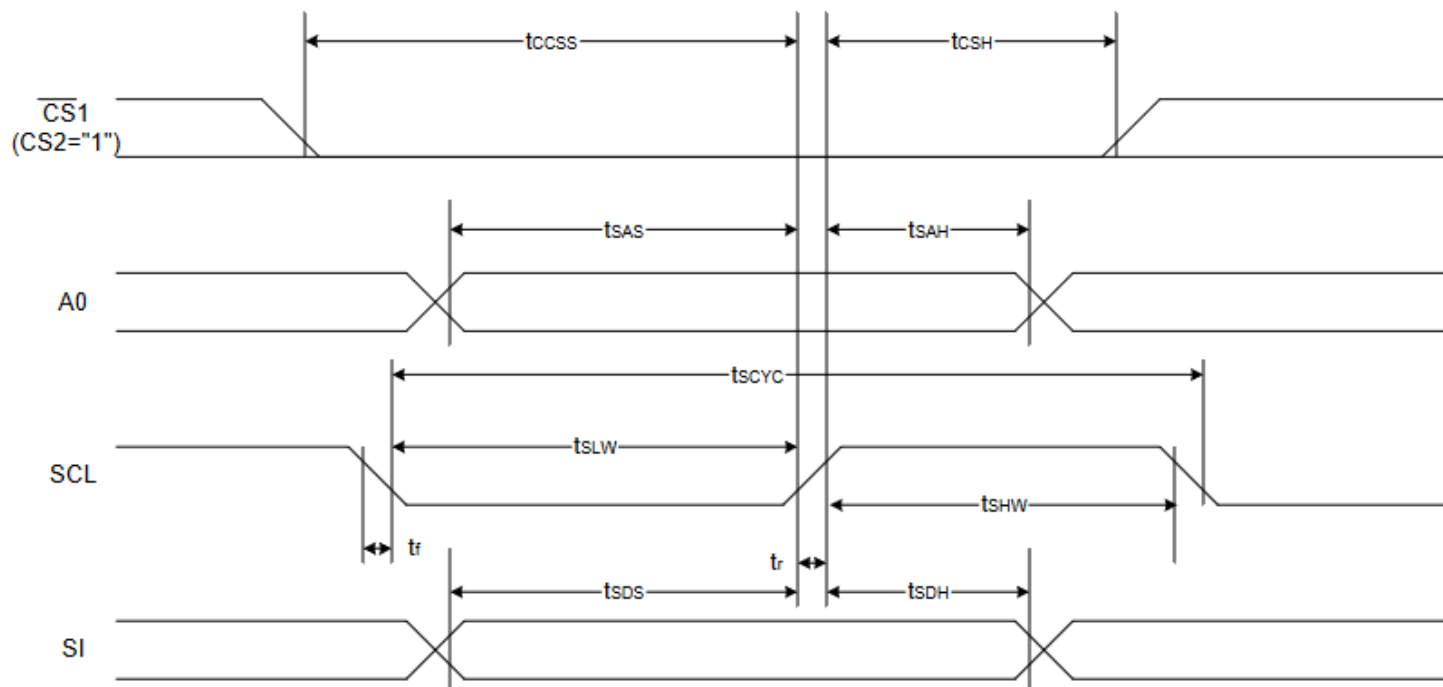


## Table of Commands

| 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                                               | 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                                  | 0            | 1   | 0   | 0          | 0  | 0                       | 1  | Most significant column address  |                |               |                                                 | Sets the most significant 4 bits of the display RAM column address.             |
| Column address set lower bit                                      |              |     |     | 0          | 0  | 0                       | 0  | Least significant column address |                |               |                                                 | Sets the least significant 4 bits of the display RAM 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                                               | 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                                               | 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                                               | 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                                               | 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                                | *              | *             | *                                               | 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 <sub>0</sub> 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                                   | 0            | 1   | 0   | 1          | 0  | 0                       | 0  | 0                                | 0              | 0             | 1                                               | Set the V <sub>0</sub> output voltage electronic volume register                |
| Electronic volume register set                                    |              |     |     | 0          | 0  | Electronic volume value |    |                                  |                |               |                                                 |                                                                                 |
| (19) Sleep mode set                                               | 0            | 1   | 0   | 1          | 0  | 1                       | 0  | 1                                | 1              | 0             | 0                                               | 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                                    |

## Timing Characteristics

### The 4-line SPI Interface



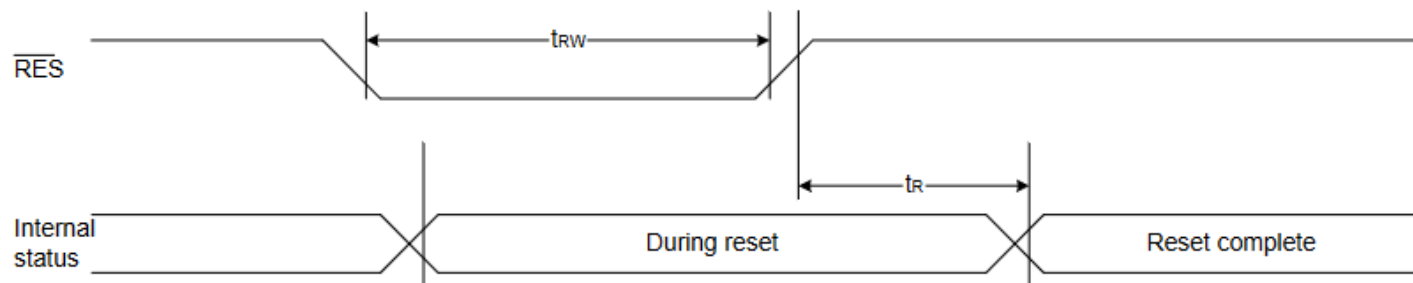
( $V_{DD} = 3.3V$ ,  $T_a = -30$  to  $85^\circ C$ )

| Item                    | Signal | Symbol     | Condition | Rating |      | Units |
|-------------------------|--------|------------|-----------|--------|------|-------|
|                         |        |            |           | Min.   | Max. |       |
| 4-line SPI Clock Period | SCL    | $T_{scyc}$ |           | 50     | —    | ns    |
| SCL "H" pulse width     |        | $T_{shw}$  |           | 25     | —    |       |
| SCL "L" pulse width     |        | $T_{SLW}$  |           | 25     | —    |       |
| Address setup time      | A0     | $T_{SAS}$  |           | 20     | —    |       |
| Address hold time       |        | $T_{SAH}$  |           | 10     | —    |       |
| Data setup time         | SI     | $T_{SDS}$  |           | 20     | —    |       |
| Data hold time          |        | $T_{SDH}$  |           | 10     | —    |       |
| CS-SCL time             | CS     | $T_{css}$  |           | 20     | —    |       |
| CS-SCL time             |        | $T_{csh}$  |           | 40     | —    |       |

\*1 The input signal rise and fall time ( $t_r$ ,  $t_f$ ) are specified at 15 ns or less.

\*2 All timing is specified using 20% and 80% of  $V_{DD}$  as the standard.

## Reset Timing



( $V_{\text{DD}} = 3.3\text{V}$ ,  $T_{\text{a}} = -30$  to  $85^{\circ}\text{C}$ )

| Item                  | Signal | Symbol          | Condition | Rating |      |      | Units |
|-----------------------|--------|-----------------|-----------|--------|------|------|-------|
|                       |        |                 |           | Min.   | Typ. | Max. |       |
| Reset time            |        | $t_{\text{R}}$  |           | —      | —    | 1.0  | us    |
| Reset "L" pulse width | /RES   | $t_{\text{RW}}$ |           | 1.0    | —    | —    | us    |

## 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                                   |      |
|                                       |                                                                                                                                 | 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.

## Looking for pricing, stock, or lifecycle information?

Click below to explore more details on WIN SOURCE:

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- ⊖ [Newhaven](#) Information

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- ✓ Global Sourcing Solution
- ✓ Obsolete Management
- ✓ Cost Control Management
- ✓ Shortage Management
- ✓ Alternative Solution
- ✓ Excess Inventory Management