

# NHD-C12864A1Z-FSB-FBW-HTT

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

|         |                         |
|---------|-------------------------|
| NHD-    | Newhaven Display        |
| C12864- | 128 x 64 Pixels         |
| A1Z-    | Model                   |
| F-      | Transflective           |
| SB-     | Side Blue LED Backlight |
| F-      | FSTN Positive           |
| B-      | 6:00 Optimal View       |
| W-      | Wide Temp               |
| HTT-    | With 12V Heater         |
|         | <b>RoHS Compliant</b>   |

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## Document Revision History

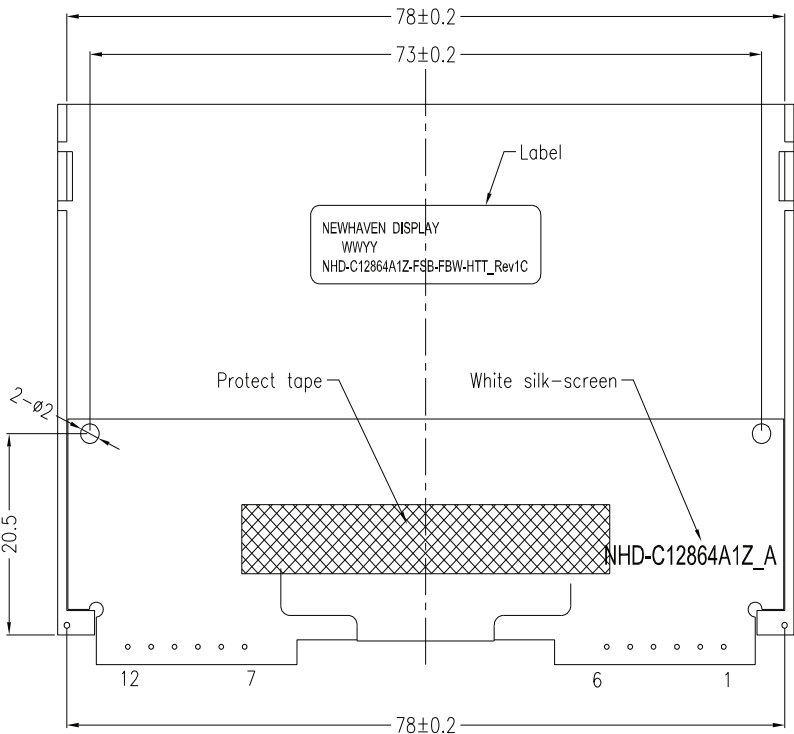
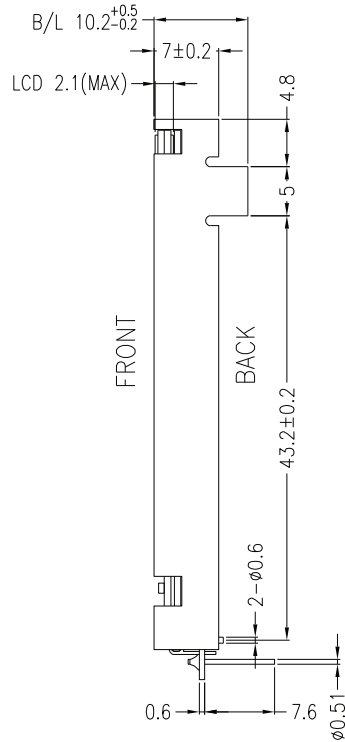
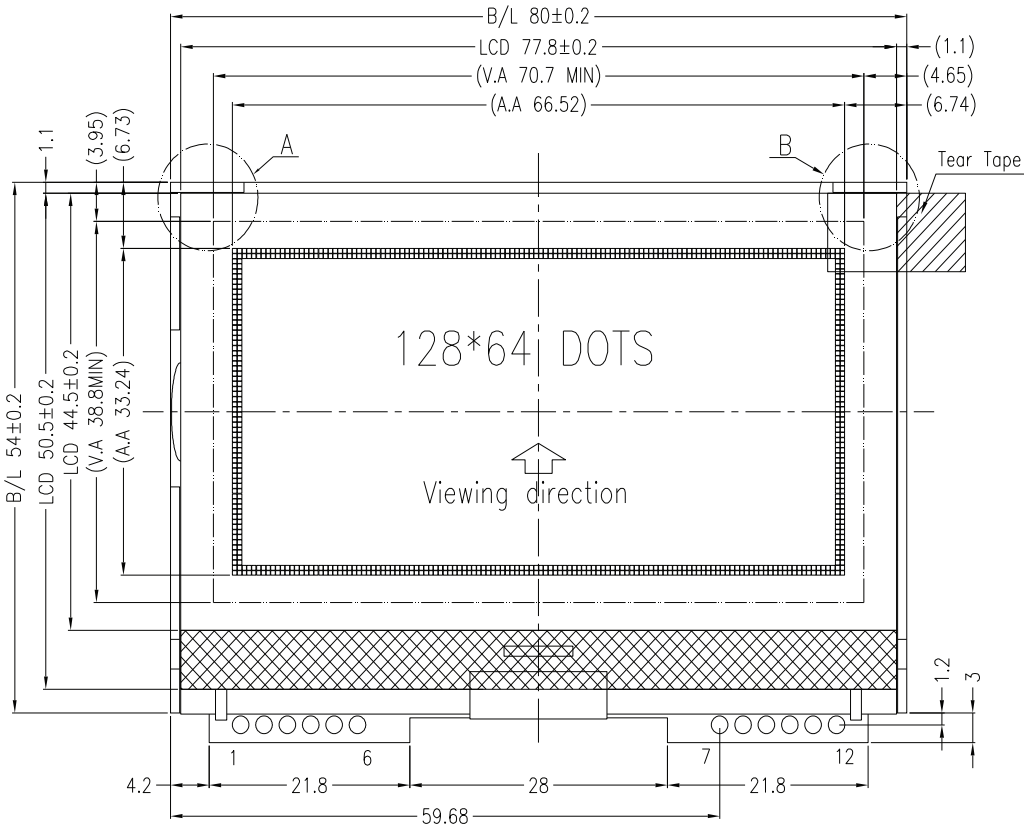
| Revision | Date     | Description                                                                                                    | Changed by |
|----------|----------|----------------------------------------------------------------------------------------------------------------|------------|
| 0        | 10/20/10 | Initial Release                                                                                                | -          |
| 1        | 10/26/10 | Pin Length Adjusted from 0.5" to 0.3" on Drawing                                                               | MC         |
| 2        | 10/27/10 | Supply Current and block diagram updated                                                                       | BE         |
| 3        | 1/20/11  | Operating Temp updated                                                                                         | BE         |
| 4        | 8/31/11  | Electrical characteristics updated                                                                             | AK         |
| 5        | 7/30/12  | Electrical characteristics updated                                                                             | AK         |
| 6        | 8/31/15  | Electrical characteristics, Mechanical drawing updated                                                         | SB         |
| 7        | 8/24/18  | Supply Current & Voltage Updated                                                                               | SB         |
| 8        | 5/13/19  | Heater Resistance Updated                                                                                      | SB         |
| 9        | 6/4/19   | Added PCB Footprint Drawing                                                                                    | AS         |
| 10       | 1/31/20  | Glass Panel Updated                                                                                            | SB         |
| 11       | 7/16/20  | Updated Serial Interface Timing Characteristics                                                                | AS         |
| 12       | 10/9/20  | Updated LCD Contrast Range from 8.5V/8.7V/8.9V to 8.8V/9.0V/9.2V<br>Part Revision Upgraded to Rev1B            | AS         |
| 13       | 4/8/21   | Updated the Electrical, Optical Characteristics, Table of Commands, Quality Information and Mechanical Drawing | JT         |

## Functions and Features

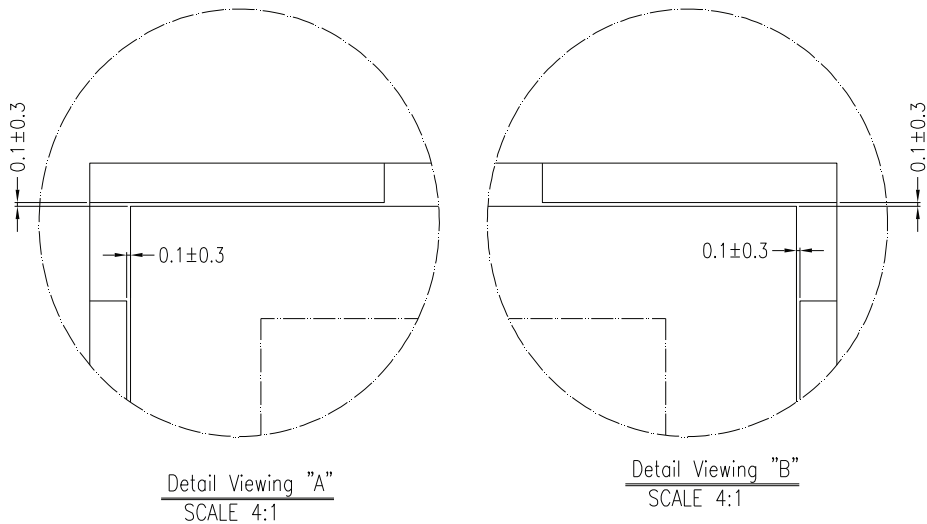
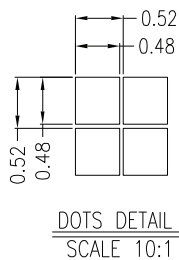
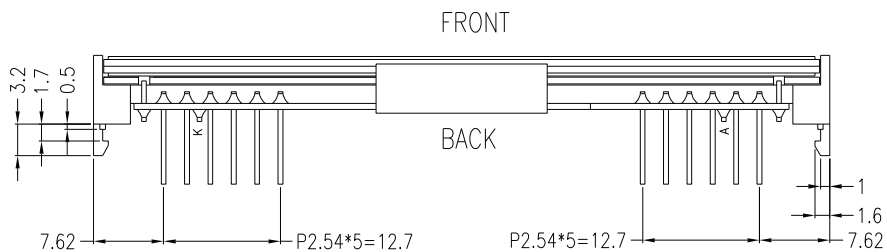
- 128 x 64 pixels
- Built-in ST7565P controller
- +3.0V power supply
- 1/65 duty cycle; 1/9 bias
- Built-in Heater
- RoHS Compliant

Mechanical Drawing

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

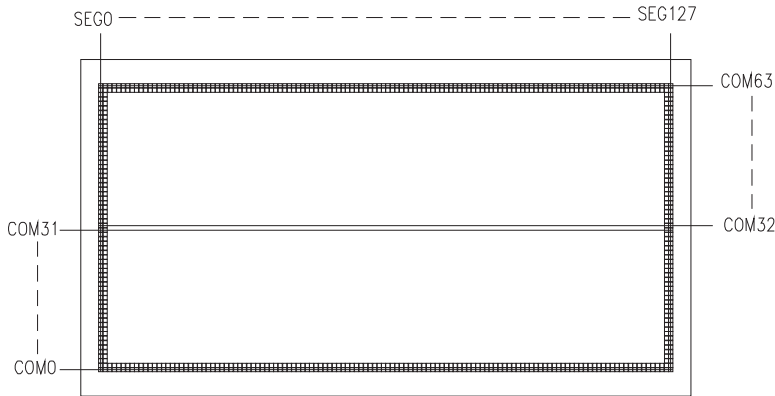


Capacitance(C1~C9): 4.7UF/50V/±10%/SMD/X5R/0805/T=1.25

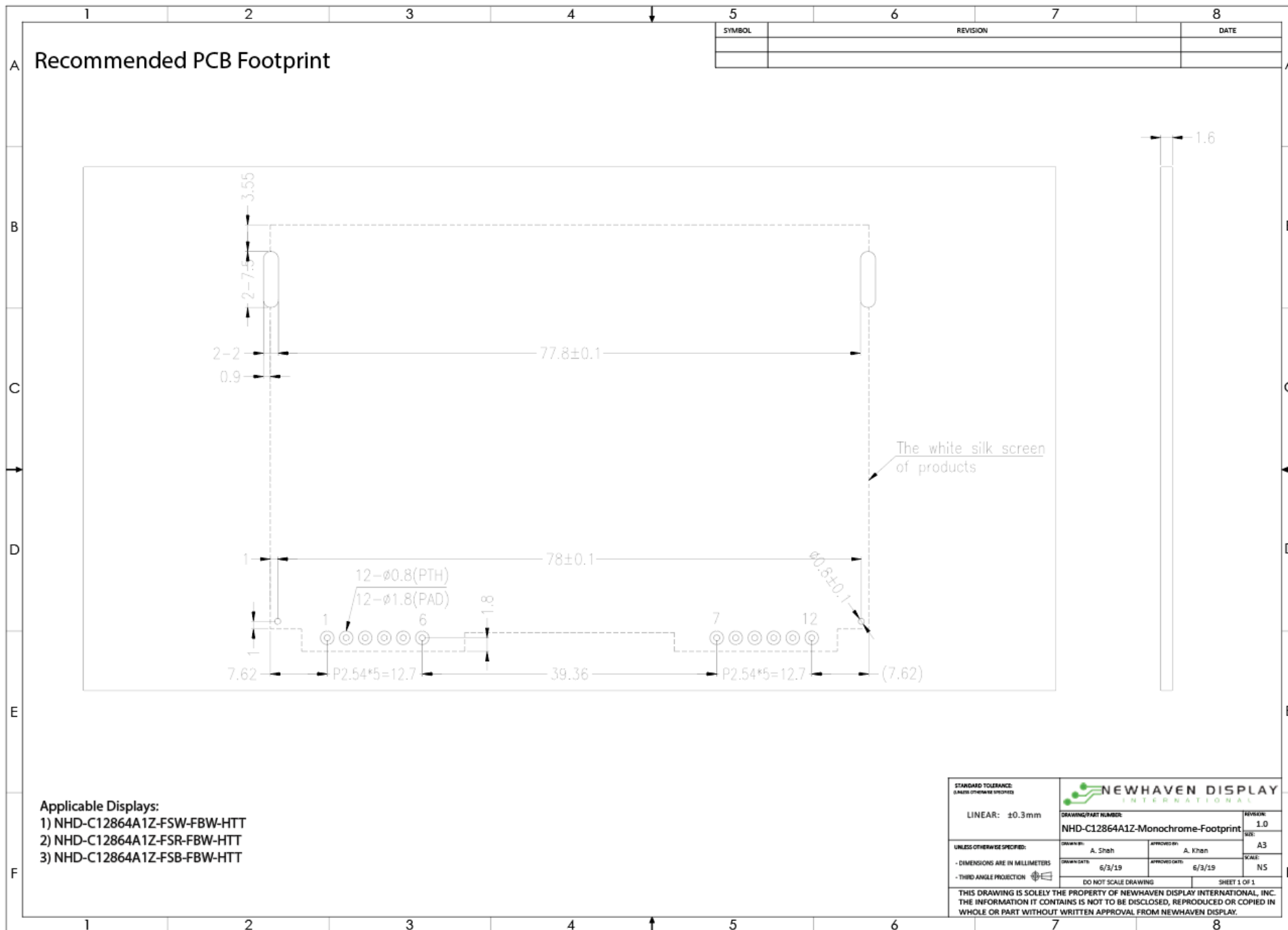


| Pin assignment |        |
|----------------|--------|
| NO.            | Symbol |
| 1              | SCL    |
| 2              | SI     |
| 3              | VDD    |
| 4              | AO     |
| 5              | /RESET |
| 6              | /CS    |
| 7              | VSS    |
| 8              | H-     |
| 9              | H+     |
| 10             | LED-   |
| 11             | LED+   |
| 12             | NC     |

1. Driver: 1/65 Duty, 1/9 Bias
2. Display Mode: FSTN Positive / Transflective
3. Optimal View: 6:00
4. Voltage: 3.0V V<sub>DD</sub>, 9.0V V<sub>LCD</sub>
5. Backlight: Blue LED
6. Driver IC: ST7565P
7. Built-In Heater



|                                                                                                                                                                                                                       |  |                                                   |                                                      |
|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--|---------------------------------------------------|------------------------------------------------------|
| STANDARD TOLERANCE:<br>(UNLESS OTHERWISE SPECIFIED)                                                                                                                                                                   |  | NEWHAVEN DISPLAY INTERNATIONAL                    |                                                      |
| LINEAR: ±0.3mm                                                                                                                                                                                                        |  | DRAWING/PART NUMBER:<br>NHD-C12864A1Z-FSB-FBW-HTT | REVISION:<br>1C                                      |
| UNLESS OTHERWISE SPECIFIED:<br>- DIMENSIONS ARE IN MILLIMETERS<br>- THIRD ANGLE PROJECTION                                                                                                                            |  | DRAWN BY:<br>J.Thomas<br>DRAWN DATE:<br>4/8/21    | APPROVED BY:<br>J.Thomas<br>APPROVED DATE:<br>4/8/21 |
|                                                                                                                                                                                                                       |  | DO NOT SCALE DRAWING                              | SHEET 1 OF 1                                         |
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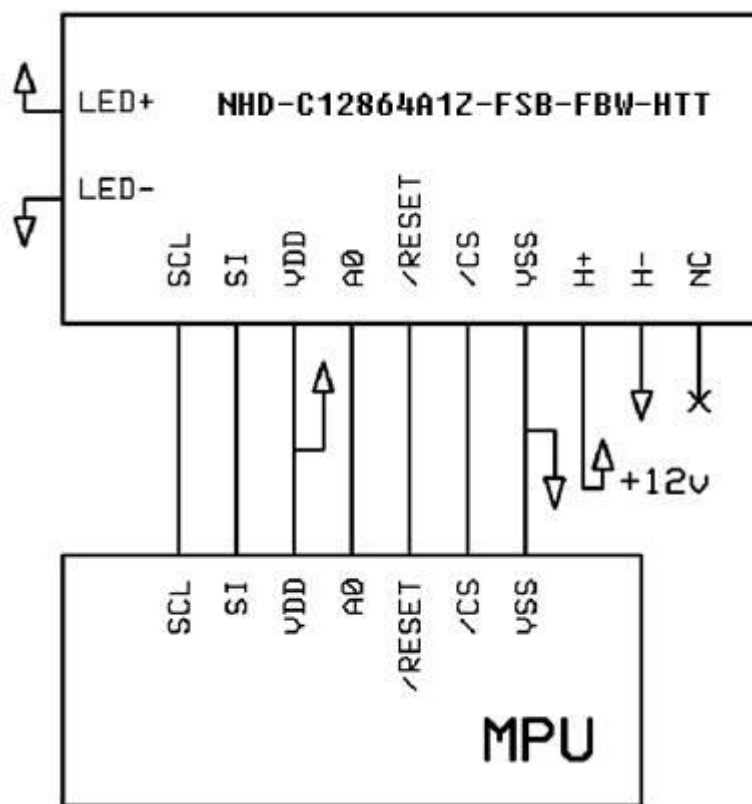
## Pin Description and Wiring Diagram

| Pin No. | Symbol          | External Connection | Function Description                     |
|---------|-----------------|---------------------|------------------------------------------|
| 1       | SCL             | MPU                 | Serial Clock input                       |
| 2       | SI              | MPU                 | Serial Data input                        |
| 3       | V <sub>DD</sub> | Power Supply        | Supply Voltage for LCD and logic (+3.0V) |
| 4       | A0              | MPU                 | Register Select. 0: instruction; 1: data |
| 5       | /RESET          | MPU                 | Operation Active LOW Reset signal        |
| 6       | /CS             | MPU                 | Active LOW Chip Select Signal            |
| 7       | V <sub>SS</sub> | Power Supply        | Ground                                   |
| 8       | H-              | Power Supply        | Ground for Heater                        |
| 9       | H+              | Power Supply        | Power for Heater (+12V)                  |
| 10      | LED-            | Power Supply        | Backlight Cathode (Ground)               |
| 11      | LED+            | Power Supply        | Backlight Anode (+3.3V)                  |
| 12      | NC              | -                   | No Connect                               |

**Recommended LCD connector:** 2.54mm pitch thru-hole connection on PCB

**Backlight connector:** --- **Mates with:** ---

**Recommended Breakout Board:** [NHD-PCB40](#)



## Electrical Characteristics

| Item                        | Symbol                          | Condition                                      | Min.                  | Typ. | Max.                  | Unit |
|-----------------------------|---------------------------------|------------------------------------------------|-----------------------|------|-----------------------|------|
| Operating Temperature Range | T <sub>OP</sub>                 | Absolute Max                                   | -40                   | -    | +70                   | °C   |
| Storage Temperature Range   | T <sub>ST</sub>                 | Absolute Max                                   | -30                   | -    | +80                   | °C   |
| Supply Voltage              | V <sub>DD</sub>                 | -                                              | 2.8                   | 3.0  | 3.2                   | V    |
| Supply Current              | I <sub>DD</sub>                 | T <sub>OP</sub> =25°C<br>V <sub>DD</sub> =3.0V | 0.1                   | 0.2  | 1.0                   | mA   |
| Supply for LCD (contrast)   | V <sub>DD</sub> -V <sub>0</sub> |                                                | 8.8                   | 9.0  | 9.2                   | V    |
| "H" Level input             | V <sub>IH</sub>                 | -                                              | 0.8 * V <sub>DD</sub> | -    | V <sub>DD</sub>       | V    |
| "L" Level input             | V <sub>IH</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>                | -                                              | 3.2                   | 3.3  | 3.4                   | V    |
| Backlight Supply Current    | I <sub>LED</sub>                | V <sub>LED</sub> = 3.3V                        | 25                    | 50   | 60                    | mA   |
|                             |                                 |                                                |                       |      |                       |      |
| Heater panel resistance     | R <sub>H</sub> +/-              | -                                              | 5                     | 20   | 35                    | Ω    |
| Heater Voltage Supply       | V <sub>H</sub>                  | -                                              | -                     | 12V  | 15                    | V    |
| Heater Current              | I <sub>H</sub>                  | V <sub>H</sub> = 12.0V                         | 0.48                  | 0.6  | 1                     | A    |
| Heater Power                | W <sub>H</sub>                  | -                                              | 5.76                  | 7.2  | 12                    | W    |

<sup>1</sup>Heater **MUST** be activated when operating temperature drops below -20°C

<sup>2</sup>Heater measured using digital multi-meter

## Optical Characteristics

| Item                   |        | Symbol         | Condition              | Min. | Typ. | Max. | Unit |
|------------------------|--------|----------------|------------------------|------|------|------|------|
| Optimal Viewing Angles | Top    | φY+            | CR ≥ 3                 | 15   | 20   | 25   | °    |
|                        | Bottom | φY-            |                        | 30   | 40   | 50   | °    |
|                        | Left   | θX-            |                        | 30   | 40   | 50   | °    |
|                        | Right  | θX+            |                        | 30   | 40   | 50   | °    |
| Contrast Ratio         |        | CR             | -                      | 2    | 4    | 10   | -    |
| Response Time          | Rise   | T <sub>R</sub> | T <sub>OP</sub> = 25°C | -    | 135  | 240  | ms   |
|                        | Fall   | T <sub>F</sub> |                        | -    | 235  | 325  | ms   |

## Controller Information

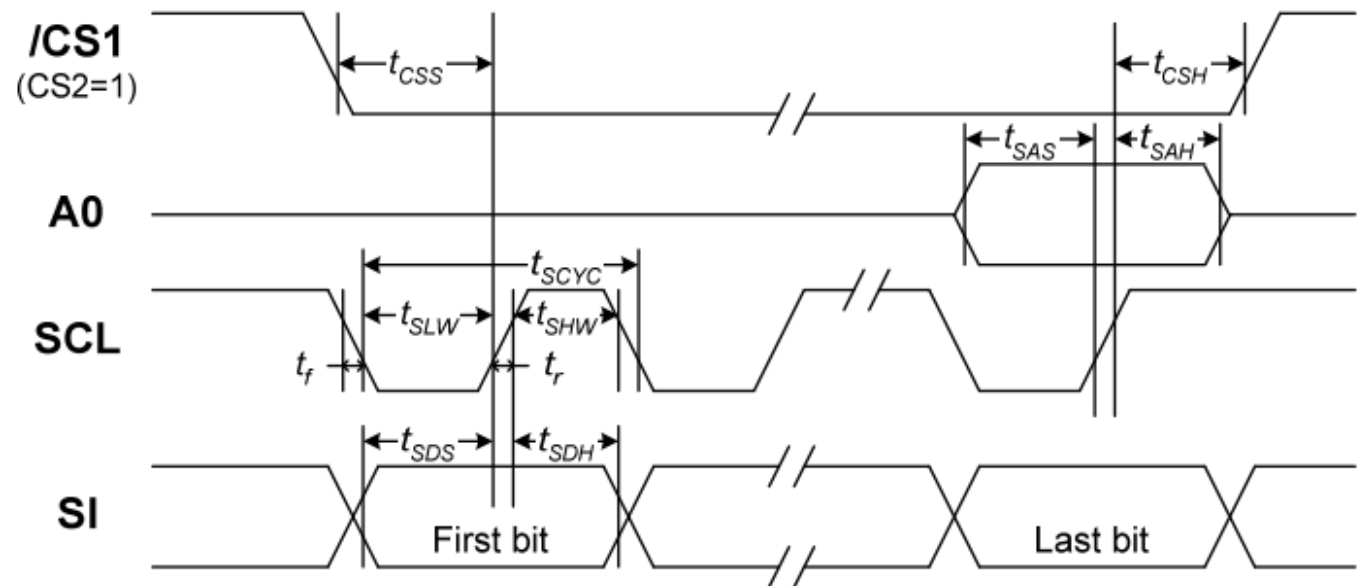
Built-in ST7565P controller.

Please download specification at

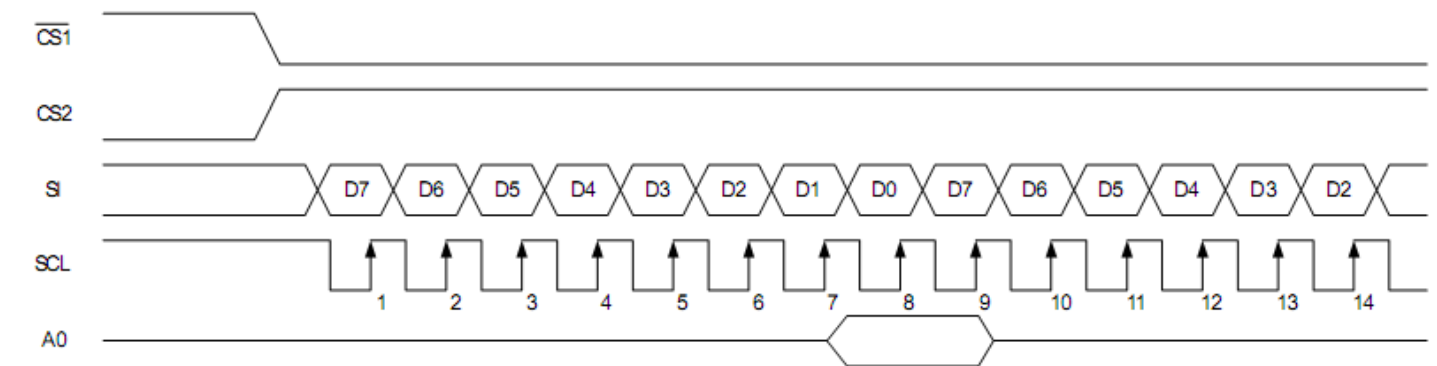
[https://www.newhavendisplay.com/resources\\_dataFiles/datasheets/LCDs/ST7565P.pdf](https://www.newhavendisplay.com/resources_dataFiles/datasheets/LCDs/ST7565P.pdf)

# Timing Characteristics

## The Serial Interface



| Item                | Signal | Symbol            | Condition | Rating |      | Units |
|---------------------|--------|-------------------|-----------|--------|------|-------|
|                     |        |                   |           | Min.   | Max. |       |
| Serial Clock Period | SCL    | $t_{\text{SCYC}}$ |           | 50     | —    | ns    |
| SCL "H" pulse width |        | $t_{\text{SHW}}$  |           | 25     | —    |       |
| SCL "L" pulse width |        | $t_{\text{SLW}}$  |           | 25     | —    |       |
| Address setup time  | A0     | $t_{\text{SAS}}$  |           | 20     | —    |       |
| Address hold time   |        | $t_{\text{SAH}}$  |           | 10     | —    |       |
| Data setup time     | SI     | $t_{\text{SDS}}$  |           | 20     | —    |       |
| Data hold time      |        | $t_{\text{SDH}}$  |           | 10     | —    |       |
| CS-SCL time         | CS     | $t_{\text{CSS}}$  |           | 20     | —    |       |
| CS-SCL time         |        | $t_{\text{CSH}}$  |           | 40     | —    |       |



## 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            | 1   | 0   | 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 (ST7565P)     |
| (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(R <sub>b</sub> /R <sub>a</sub> ) 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 |    |                                  |                |    |                            |                                                                                 |
| (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                        |
| (21) Power saver                                                  |              |     |     |            |    |                         |    |                                  |                |    |                            | Display OFF and display all points ON compound command                          |
| (22) NOP                                                          | 0            | 1   | 0   | 1          | 1  | 1                       | 0  | 0                                | 0              | 1  | 1                          | Command for non-operation                                                       |
| (23) Test                                                         | 0            | 1   | 0   | 1          | 1  | 1                       | 1  | *                                | *              | *  | *                          | Command for IC test. Do not use this command                                    |

## Example Initialization Program

.....

```
Sub Command
Reset P3.7
Reset P3.4
For Writecount = 1 To 8
  Rotate A , Left , 1
  Reset P3.1
  P1 = A
  Set P3.1
Next Writecount
Set P3.7
End Sub
```

.....

```
Sub Write
Reset P3.7
Set P3.4
For Writecount = 1 To 8
  Rotate A , Left , 1
  Reset P3.1
  P1 = A
  Set P3.1
Next Writecount
Set P3.7
End Sub
```

.....

```
Sub Init
Waitms 100
A = &HA0
Call Command
A = &HAE
Call Command
A = &HC0
Call Command
A = &HA2
Call Command
A = &H2F
Call Command
A = &H26
Call Command
A = &H81
Call Command
A = &H11
Call Command
A = &HAF
Call Command
End Sub
```

.....

## 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.                                                            | -40°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.                     | -40°C / -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. | +50°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.                  | -40°C / -20°C , 60min --> 70°C ,<br>60min = 1 cycle<br>For 20 cycles                           |      |
| Vibration test                        | Endurance test applying vibration to simulate transportation and use.                                                           | 10-50Hz , Acceleration of Gravity:5G<br>30 min in each of 3 directions X,Y,Z<br>For 15 minutes | 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.

## Precautions for using LCDs/LCMs

See Precautions at [www.newhavendisplay.com/specs/precautions.pdf](http://www.newhavendisplay.com/specs/precautions.pdf)

## Warranty Information and Terms & Conditions

[http://www.newhavendisplay.com/index.php?main\\_page=terms](http://www.newhavendisplay.com/index.php?main_page=terms)

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