

NHD-C12832A1Z-FS(RGB)-FBW-3V

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

| | |
|---------|-----------------------------------|
| NHD- | Newhaven Display |
| C12832- | 128 x 32 Pixels |
| A1Z- | Model |
| F- | Transflective |
| SRGB- | Side Red/Green/Blue LED Backlight |
| F- | FSTN Positive |
| B- | 6:00 Optimal View |
| W- | Wide Temp |
| 3V- | 3VDD |
| | RoHS Compliant |

Newhaven Display International, Inc.

2661 Galvin Ct.

Elgin IL, 60124

Ph: 847-844-8795

Fax: 847-844-8796

www.newhavendisplay.com

nhtech@newhavendisplay.com

nhsales@newhavendisplay.com

Document Revision History

| Revision | Date | Description | Changed by |
|----------|------------|---|------------|
| 0 | 10/23/2012 | Initial Release | AK |
| 1 | 6/15/16 | Mechanical Drawing, Electrical & Optical Char., Quality Information Updated | SB |
| 2 | 1/23/17 | Mechanical Drawing & Electrical Characteristics Updated | SB |
| 3 | 4/14/17 | Backlight Characteristics Updated | SB |
| 4 | 8/4/17 | Backlight Characteristics Updated | SB |
| 5 | 4/2/18 | Electrical Characteristics Updated | SB |
| 6 | 6/24/19 | Added PCB Footprint Drawing | AS |
| 7 | 1/30/20 | Glass Panel Updated | SB |
| 8 | 6/17/20 | Updated 2D Mechanical Drawing, Backlight Current for Red LED, & Quality Information | AS |
| 9 | 4/20/21 | Updated Wiring Diagram | ZP |

Functions and Features

- 128 x 32 pixels
- 4-line SPI MPU interfaces
- Built-in ST7565R controller
- +3.0V power supply
- 1/33 duty cycle; 1/6 bias
- RoHS Compliant

A

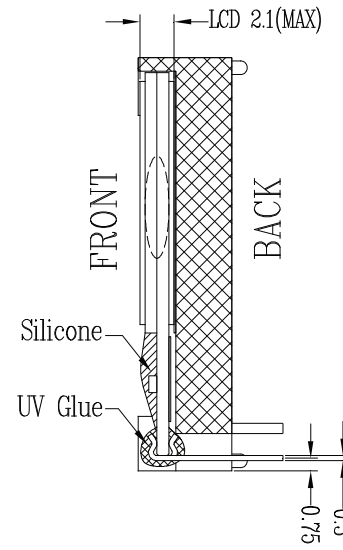
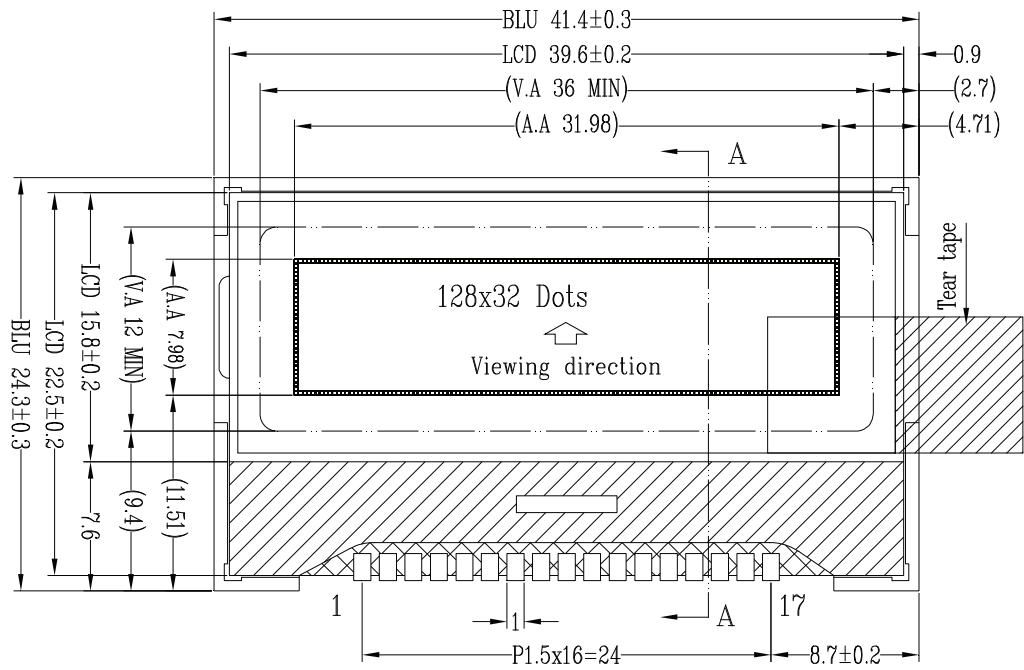
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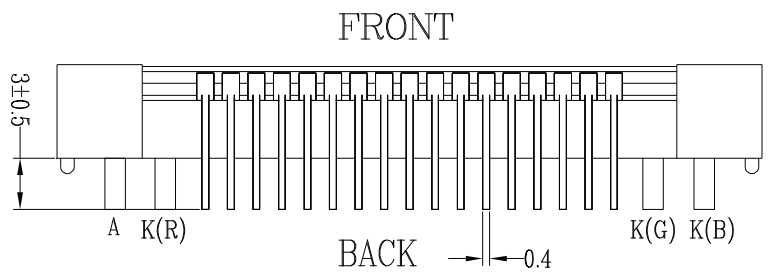
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SECTION A-A



- Notes:**
- 1. Driver: 1/33 Duty, 1/6 Bias
 - 2. Voltage: 3.3V V_{DD}, 6V V_{LCD}
 - 3. Display Mode: FSTN Positive / Transflective
 - 4. Optimal View: 6:00
 - 5. Backlight: Red, Green, Blue LED
 - 6. Driver IC: ST7565R, 4-Wire SPI

1

2

3

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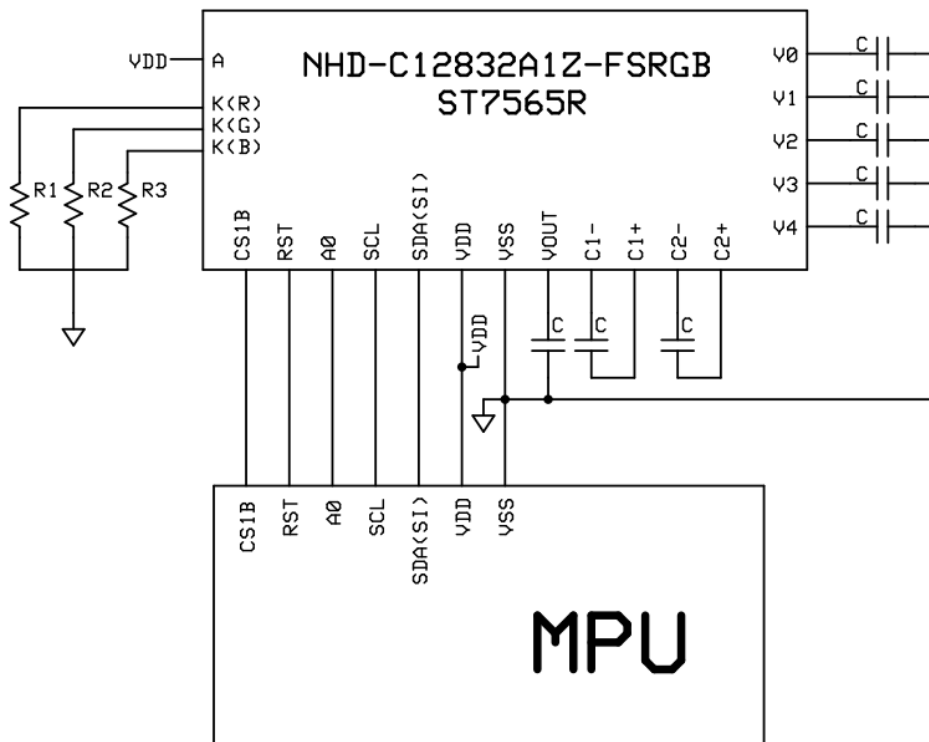
Pin Description and Wiring Diagram

| 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 V _{SS} (pin 11) |
| 11 | V _{SS} | Power Supply | Ground |
| 12 | V _{DD} | Power Supply | Supply Voltage for LCD and Logic (+3V) |
| 13 | SDA(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 | CS1B | MPU | Active LOW Chip Select signal |
| A | LED+ | Power Supply | Backlight Anode |
| K(R) | (R)LED- | Power Supply | Red Backlight Cathode (Ground) |
| K(G) | (G)LED- | Power Supply | Green Backlight Cathode (Ground) |
| K(B) | (B)LED- | Power Supply | Blue Backlight Cathode (Ground) |

Recommended LCD connector: 1.5mm pitch pins, solder directly into PCB

Backlight connector: 1.5mm wide pins solder directly into PCB **Mates with:** ---

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



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 | V _{DD} | - | 2.7 | 3.0 | 3.3 | V |
| Supply Current | I _{DD} | V _{DD} =3.0V | 0.1 | 0.4 | 1 | 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 – Red | V _{LED} | - | 2.0 | 2.1 | 2.2 | V |
| Backlight supply current – Red | I _{LED} | V _{LED} = 2.1V | 3 | 10 | 15 | mA |
| Backlight supply voltage – Green | V _{LED} | - | 2.9 | 3.0 | 3.1 | V |
| Backlight supply current – Green | I _{LED} | V _{LED} = 3.0V | 5 | 30 | 36 | mA |
| Backlight supply voltage – Blue | V _{LED} | - | 2.9 | 3.0 | 3.1 | V |
| Backlight supply current – Blue | I _{LED} | V _{LED} = 3.0V | 5 | 30 | 36 | mA |

Optical Characteristics

| Item | Symbol | Condition | Min. | Typ. | Max. | Unit |
|------------------------|--------|------------------------|------|------|------|------|
| Optimal Viewing Angles | Top | CR≥2 | - | 20 | - | ° |
| | Bottom | | - | 40 | - | ° |
| | Left | | - | 40 | - | ° |
| | Right | | - | 40 | - | ° |
| Contrast Ratio | CR | - | 2 | 4 | - | - |
| Response Time | Rise | T _{OP} = 25°C | - | 200 | 250 | ms |
| | Fall | | - | 250 | 320 | ms |

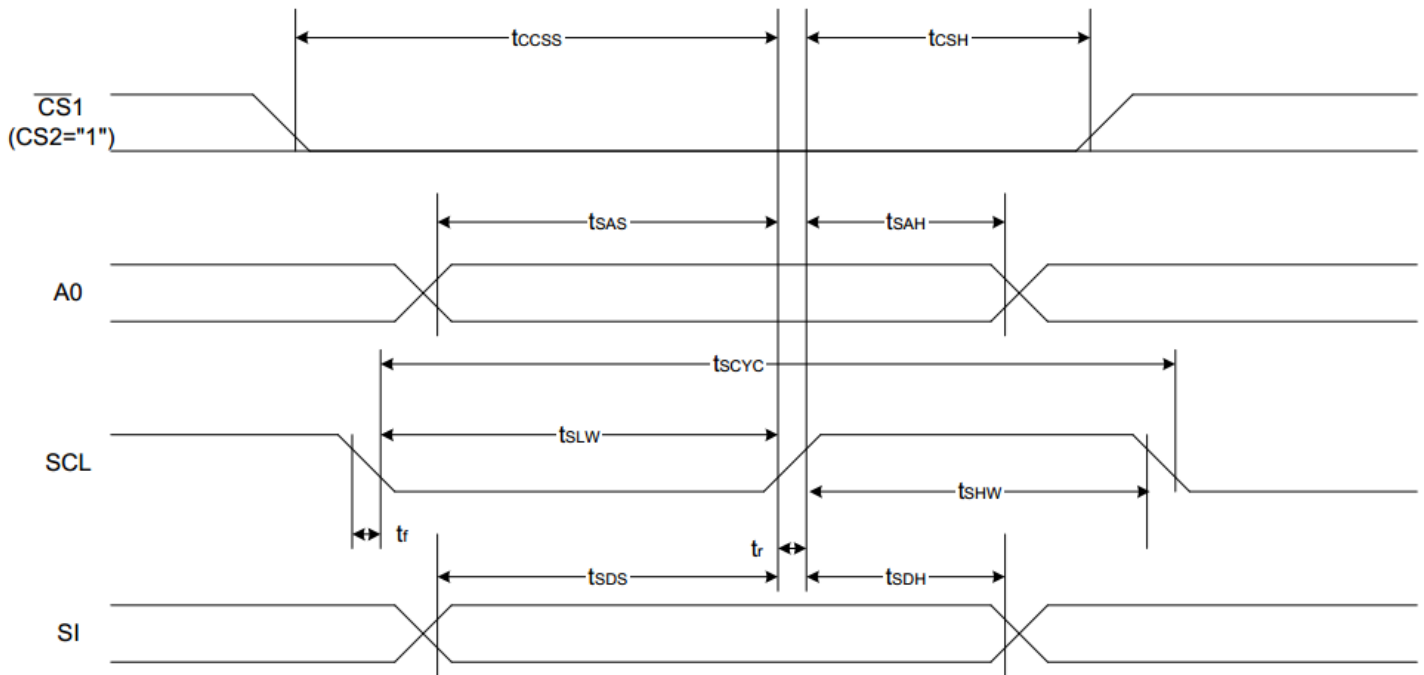
Controller Information

Built-in ST7565R controller.

Please download specification at http://www.newhavendisplay.com/app_notes/ST7565R.pdf

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 | — | |

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 | 1 | LCD display ON/OFF 0: OFF, 1: ON |
| (2) Display start line set | 0 | 1 | 0 | 0 | 1 | Display start address | | | | | 0 | Sets the display RAM display start line address | |
| (3) Page address set | 0 | 1 | 0 | 1 | 0 | 1 | Page address | | | | | 0 | Sets the display RAM page address |
| (4) Column address set upper bit | 0 | 1 | 0 | 0 | 0 | 0 | 1 | Most significant column address | | | | 0 | 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 | | | | 0 | Sets the least significant 4 bits of the display RAM column address. |
| (5) Status read | 0 | 0 | 1 | Status | | | | 0 | 0 | 0 | 0 | 0 | Reads the status data |
| (6) Display data write | 1 | 1 | 0 | Write data | | | | | | | 0 | Writes to the display RAM | |
| (7) Display data read | 1 | 0 | 1 | Read data | | | | | | | 0 | Reads from the display RAM | |
| (8) ADC select | 0 | 1 | 0 | 1 | 0 | 1 | 0 | 0 | 0 | 0 | 0 | 1 | Sets the display RAM address SEG output correspondence 0: normal, 1: reverse |
| (9) Display normal/reverse | 0 | 1 | 0 | 1 | 0 | 1 | 0 | 0 | 1 | 1 | 0 | 1 | Sets the LCD display normal/ reverse 0: normal, 1: reverse |
| (10) Display all points ON/OFF | 0 | 1 | 0 | 1 | 0 | 1 | 0 | 0 | 1 | 0 | 0 | 1 | Display all points 0: normal display 1: all points ON |
| (11) LCD bias set | 0 | 1 | 0 | 1 | 0 | 1 | 0 | 0 | 0 | 1 | 0 | 1 | Sets the LCD drive voltage bias ratio 0: 1/9 bias, 1: 1/7 bias (ST7565R) |
| (12) Read-modify-write | 0 | 1 | 0 | 1 | 1 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | Column address increment At write: +1 At read: 0 |
| (13) End | 0 | 1 | 0 | 1 | 1 | 1 | 0 | 1 | 1 | 1 | 0 | 0 | Clear read/modify/write |
| (14) Reset | 0 | 1 | 0 | 1 | 1 | 1 | 0 | 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 0: normal direction 1: reverse direction |
| (16) Power control set | 0 | 1 | 0 | 0 | 0 | 1 | 0 | 1 | Operating mode | | 0 | 0 | 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 | | | 0 | Select internal resistor ratio(Rb/Ra) mode |
| (18) Electronic volume mode set | 0 | 1 | 0 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | Set the V ₀ output voltage electronic volume register |
| Electronic volume register set | | | | 0 | 0 | Electronic volume value | | | | | 0 | | |
| (19) Sleep mode set | 0 | 1 | 0 | 1 | 0 | 1 | 0 | 1 | 1 | 0 | 0 | 1 | 0: Sleep mode, 1: Normal mode |
| (20) Booster ratio set | 0 | 1 | 0 | 1 | 1 | 1 | 1 | 1 | 0 | 0 | 0 | 0 | select booster ratio 00: 2x,3x,4x 01: 5x 11: 6x |
| | | | | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | step-up value | |
| (21) NOP | 0 | 1 | 0 | 1 | 1 | 1 | 0 | 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(0x26);
    comm_out(0x81);
    comm_out(0x2F);
}

/*****/
```

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. | +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. | -20°C,60min -> 70°C,60min = 1 cycle 20 cycles | |
| Vibration test | Endurance test applying vibration to simulate transportation and use. | 10-50Hz 5G Acceleration. 30 min 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.

Precautions for using LCDs/LCMs

See Precautions at www.newhavendisplay.com/specs/precautions.pdf

Warranty Information and Terms & Conditions

http://www.newhavendisplay.com/index.php?main_page=terms

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