

# NHD-0208BZ-FSW-GBW-33V3

## Character Liquid Crystal Display Module

|       |                                |
|-------|--------------------------------|
| NHD-  | Newhaven Display               |
| 0208- | 2 lines x 8 characters         |
| BZ-   | Model                          |
| F-    | Transflective                  |
| SW-   | Side White LED Backlight       |
| G-    | STN- Gray                      |
| B-    | 6:00 view                      |
| W-    | Wide Temperature (-20°C~+70°C) |
| 33V3- | 3.3 VDD, 3 Volt Backlight      |

**RoHS Compliant**

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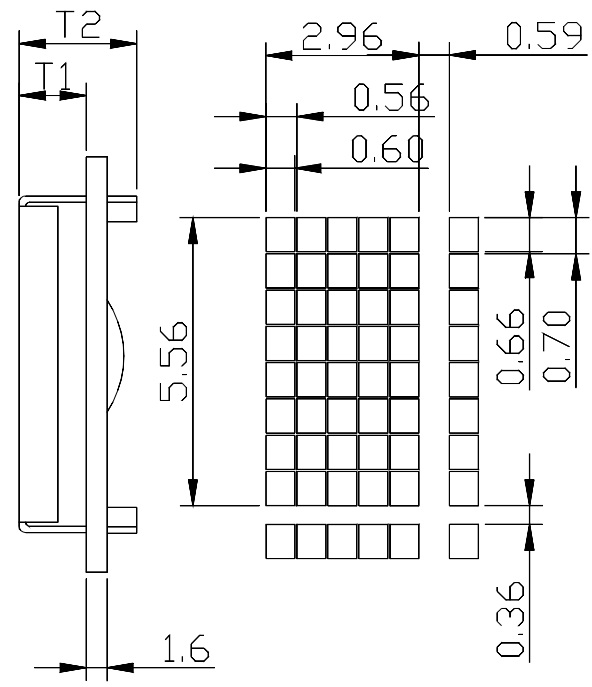
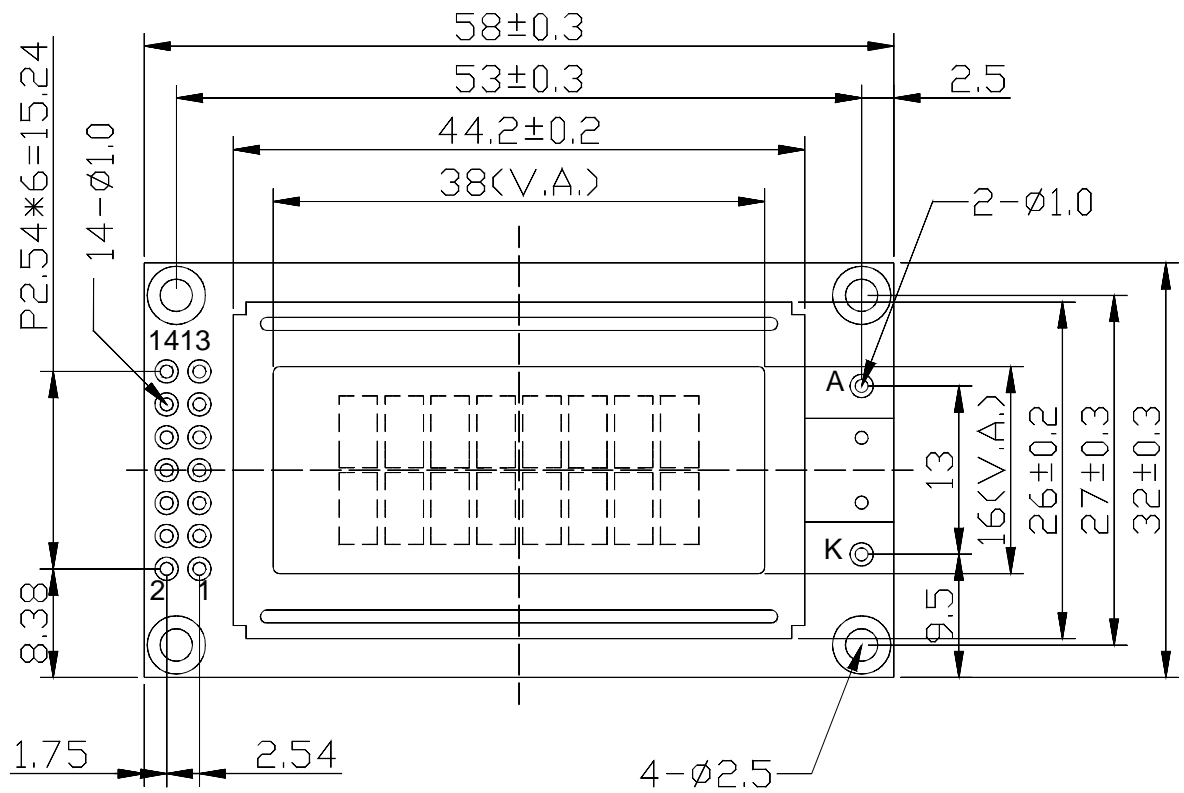
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## Document Revision History

| Revision | Date      | Description                       | Changed by |
|----------|-----------|-----------------------------------|------------|
| 0        | 2/10/2012 | 33V – improved liquid; VDD = 3.3V | SB         |

## Functions and Features

- 2 lines x 8 characters
- Built-in controller (ST7066U or equivalent)
- +3.3V Power Supply
- 1/16 duty, 1/5 bias
- RoHS compliant



**PIN ASSIGNMENT**

|       |         |
|-------|---------|
| 1     | VSS     |
| 2     | VDD     |
| 3     | V0      |
| 4     | RS      |
| 5     | R/W     |
| 6     | E       |
| 7~10  | DB0~DB3 |
| 11~14 | DB4~DB7 |
| A     | LED+    |
| K     | LED-    |

|             | T1  | T2   | UNIT |
|-------------|-----|------|------|
| WITHOUT BKL | 4.0 | 8.0  | mm   |
| SIDE BKL    | 9.0 | 13.0 | mm   |
| ARRAY BKL   | 9.0 | 13.0 | mm   |

**Feature**

1. 8 Character X 2-line Character Format; 5X7 dots + 1-Cursor line.
2. Driver: ST7066U
3. Interface With 4-bit or 8-bit MPU; 1/16 Duty cycle, 1/5 Bias.
4. Display Mode & Backlight Variations.
5. ROHS Compliant

**Newhaven Display**

Model Name:

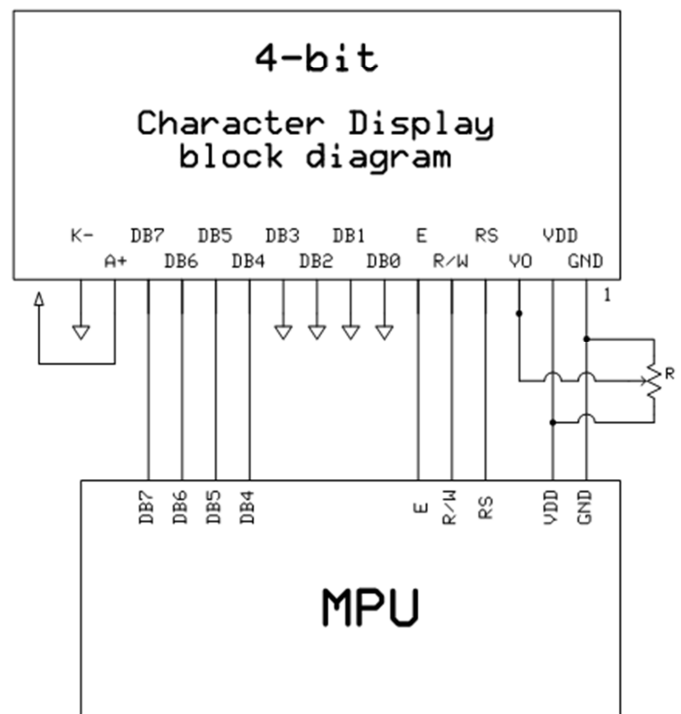
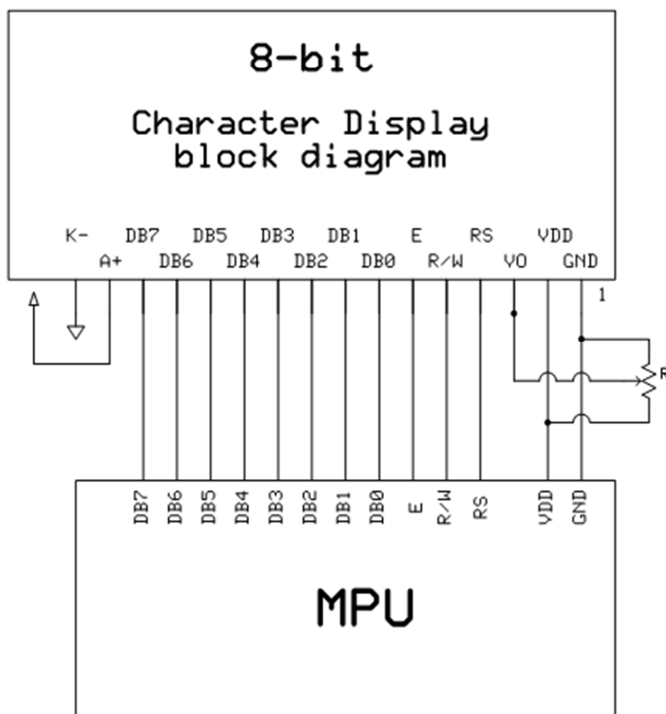
NHD-0208BZ-FSW-GBW-33V3

## Pin Description and Wiring Diagram

| Pin No. | Symbol    | External Connection | Function Description  |
|---------|-----------|---------------------|---|
| 1       | VSS       | Power Supply        | Ground  |
| 2       | VDD       | Power Supply        | Supply Voltage for logic (+3.3V)  |
| 3       | VO        | Adj Power Supply    | Power supply for contrast (approx. 0.1V)  |
| 4       | RS        | MPU                 | Register select signal. RS=0: Command, RS=1: Data   |
| 5       | R/W       | MPU                 | Read/Write select signal, R/W=1: Read R/W: =0: Write  |
| 6       | E         | MPU                 | Operation enable signal. Falling edge triggered.  |
| 7-10    | DB0 – DB3 | MPU                 | Four low order bi-directional three-state data bus lines. These four are not used during 4-bit operation. |
| 11-14   | DB4 – DB7 | MPU                 | Four high order bi-directional three-state data bus lines.  |
| A       | LED+      | Power Supply        | Power supply for LED Backlight (+3.0V)  |
| K       | LED-      | Power Supply        | Ground for Backlight  |

Recommended LCD connector: 2.54mm pitch pins

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



## Electrical Characteristics

| Item                        | Symbol | Condition         | Min.     | Typ. | Max.    | Unit |
|-----------------------------|--------|-------------------|----------|------|---------|------|
| Operating Temperature Range | Top    | Absolute Max      | -20      | -    | +70     | °C   |
| Storage Temperature Range   | Tst    | Absolute Max      | -30      | -    | +80     | °C   |
| Supply Voltage              | VDD    |                   | -        | 3.3  | 5.5     | V    |
| Supply Current              | IDD    | Ta=25°C, VDD=3.3V | -        | 1.0  | 1.5     | mA   |
| Supply for LCD (contrast)   | VDD-V0 | Ta=25°C           | -        | 3.2  | -       | V    |
| "H" Level input             | Vih    |                   | 0.7 VDD  | -    | VDD     | V    |
| "L" Level input             | Vil    |                   | 0        | -    | 0.6     | V    |
| "H" Level output            | Voh    |                   | 0.75 VDD | -    | -       | V    |
| "L" Level output            | Vol    |                   | -        | -    | 0.2 VDD | V    |
|                             |        |                   |          |      |         |      |
| Backlight Supply Voltage    | Vled   | -                 | -        | 3.0  | -       | V    |
| Backlight Supply Current    | Iled   | Vled=3.0V         | -        | 15   | 25      | mA   |

## Optical Characteristics

| Item                               | Symbol | Condition | Min. | Typ. | Max. | Unit |
|------------------------------------|--------|-----------|------|------|------|------|
| Viewing Angle - Vertical (top)     | AV     | Cr ≥ 2    | -    | 25   | -    | °    |
| Viewing Angle - Vertical (bottom)  | AV     | Cr ≥ 2    | -    | 70   | -    | °    |
| Viewing Angle - Horizontal (left)  | AH     | Cr ≥ 2    | -    | 30   | -    | °    |
| Viewing Angle - Horizontal (right) | AH     | Cr ≥ 2    | -    | 30   | -    | °    |
| Contrast Ratio                     | Cr     |           | -    | 2    | -    | -    |
| Response Time (rise)               | Tr     | -         | -    | 120  | 150  | ms   |
| Response Time (fall)               | Tf     | -         | -    | 120  | 150  | ms   |

## Controller Information

Built-in ST7066U. Download specification at [http://www.newhavendisplay.com/app\\_notes/ST7066U.pdf](http://www.newhavendisplay.com/app_notes/ST7066U.pdf)

## Display character address code

| Location      | 1  | 2  | 3  | 4  | 5  | 6  | 7  | 8  |
|---------------|----|----|----|----|----|----|----|----|
| Address (HEX) | 00 | 01 | 02 | 03 | 04 | 05 | 06 | 07 |
| Line-2        | 40 | 41 | 42 | 43 | 44 | 45 | 46 | 47 |

## Command Table

| Instruction                | Instruction code |     |     |     |     |     |     |     |     |     | Description | Execution time (fosc= 270 KHZ)   |        |
|----------------------------|------------------|-----|-----|-----|-----|-----|-----|-----|-----|-----|-------------|--|--------|
|                            | RS               | R/W | DB7 | DB6 | DB5 | DB4 | DB3 | DB2 | DB1 | DB0 |             |  |        |
| Clear Display              | 0                | 0   | 0   | 0   | 0   | 0   | 0   | 0   | 0   | 0   | 1           | Write "20H" to DDRA and set DDRAM address to "00H" from AC   | 1.53ms |
| Return Home                | 0                | 0   | 0   | 0   | 0   | 0   | 0   | 0   | 0   | 1   | -           | Set DDRAM address to "00H" From AC and return cursor to its original position if shifted. The contents of DDRAM are not changed. | 1.53ms |
| Entry mode Set             | 0                | 0   | 0   | 0   | 0   | 0   | 0   | 0   | 1   | I/D | SH          | Assign cursor moving direction And blinking of entire display  | 39us   |
| Display ON/OFF control     | 0                | 0   | 0   | 0   | 0   | 0   | 0   | 1   | D   | C   | B           | Set display (D), cursor (C), and Blinking of cursor (B) on/off Control bit.  |        |
| Cursor or Display shift    | 0                | 0   | 0   | 0   | 0   | 0   | 1   | S/C | R/L | -   | -           | Set cursor moving and display Shift control bit, and the Direction, without changing of DDRAM data.                              | 39us   |
| Function set               | 0                | 0   | 0   | 0   | 0   | 1   | DL  | N   | F   | -   | -           | Set interface data length (DL: 8-Bit/4-bit), numbers of display Line (N: =2-line/1-line) and, Display font type (F: 5x11/5x8)    | 39us   |
| Set CGRAM Address          | 0                | 0   | 0   | 1   | AC5 | AC4 | AC3 | AC2 | AC1 | AC0 |             | Set CGRAM address in address counter.  | 39us   |
| Set DDRAM Address          | 0                | 0   | 1   | AC6 | AC5 | AC4 | AC3 | AC2 | AC1 | AC0 |             | Set DDRAM address in address counter.  | 39us   |
| Read busy Flag and Address | 0                | 1   | BF  | AC6 | AC5 | AC4 | AC3 | AC2 | AC1 | AC0 |             | Whether during internal Operation or not can be known By reading BF. The contents of Address counter can also be read.           | 0us    |
| Write data To Address      | 1                | 0   | D7  | D6  | D5  | D4  | D3  | D2  | D1  | D0  |             | Write data into internal RAM (DDRAM/CGRAM).  | 43us   |
| Read data From RAM         | 1                | 1   | D7  | D6  | D5  | D4  | D3  | D2  | D1  | D0  |             | Read data from internal RAM (DDRAM/CGRAM).   | 43us   |

# Built-in Font Table

| Upper 4 Bits<br>Lower 4 Bits | 0000       | 0001 | 0010 | 0011 | 0100 | 0101 | 0110 | 0111 | 1000 | 1001 | 1010 | 1011 | 1100 | 1101 | 1110 | 1111 |
|------------------------------|------------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|
| xxxx0000                     | CG RAM (1) |      |      | 0    | a    | P    | `    | P    |      |      |      | -    | 夕    | 三    | α    | ρ    |
| xxxx0001                     | (2)        |      | !    | 1    | A    | Q    | a    | q    |      |      | 。    | ア    | チ    | △    | ä    | q    |
| xxxx0010                     | (3)        |      | "    | 2    | B    | R    | b    | r    |      |      | 「    | イ    | ツ    | ×    | ß    | θ    |
| xxxx0011                     | (4)        |      | #    | 3    | C    | S    | c    | s    |      |      | 」    | ウ    | テ    | モ    | ε    | ∞    |
| xxxx0100                     | (5)        |      | \$   | 4    | D    | T    | d    | t    |      |      | 、    | エ    | ト    | ト    | μ    | Ω    |
| xxxx0101                     | (6)        |      | %    | 5    | E    | U    | e    | u    |      |      | ・    | オ    | ナ    | 1    | ε    | ü    |
| xxxx0110                     | (7)        |      | &    | 6    | F    | V    | f    | v    |      |      | ヲ    | カ    | ニ    | ヨ    | ρ    | Σ    |
| xxxx0111                     | (8)        |      | '    | 7    | G    | W    | g    | w    |      |      | ア    | キ    | ヌ    | ウ    | g    | π    |
| xxxx1000                     | (1)        |      | (    | 8    | H    | X    | h    | x    |      |      | イ    | ク    | ホ    | リ    | 、    | ×    |
| xxxx1001                     | (2)        |      | )    | 9    | I    | Y    | i    | y    |      |      | ウ    | ケ    | ル    | ル    | 、    | y    |
| xxxx1010                     | (3)        |      | *    | :    | J    | Z    | j    | z    |      |      | エ    | コ    | ン    | レ    | j    | ≠    |
| xxxx1011                     | (4)        |      | +    | ;    | K    | [    | k    | (    |      |      | オ    | サ    | ヒ    | ロ    | *    | ≠    |
| xxxx1100                     | (5)        |      | ,    | <    | L    | ¥    | l    | l    |      |      | カ    | シ    | フ    | ワ    | φ    | ≠    |
| xxxx1101                     | (6)        |      | -    | =    | M    | ]    | m    | )    |      |      | ユ    | ズ    | 、    | ン    | ≠    | ÷    |
| xxxx1110                     | (7)        |      | .    | >    | N    | ^    | n    | ÷    |      |      | ヨ    | セ    | ホ    | 、    | ñ    |      |
| xxxx1111                     | (8)        |      | /    | ?    | O    | _    | o    | €    |      |      | ッ    | リ    | マ    | 、    | ö    | ■    |

## Example Initialization Program

```
8-bit Initialization:
/*****/
void command(char i)
{
    P1 = i;           //put data on output Port
    D_I =0;          //D/I=LOW : send instruction
    R_W =0;          //R/W=LOW : Write
    E = 1;
    Delay(1);        //enable pulse width >= 300ns
    E = 0;           //Clock enable: falling edge
}
/*****/
void write(char i)
{
    P1 = i;           //put data on output Port
    D_I =1;          //D/I=LOW : send data
    R_W =0;          //R/W=LOW : Write
    E = 1;
    Delay(1);        //enable pulse width >= 300ns
    E = 0;           //Clock enable: falling edge
}
/*****/
void init()
{
    E = 0;
    Delay(100);      //Wait >15 msec after power is applied
    command(0x30);    //command 0x30 = Wake up
    Delay(30);        //must wait 5ms, busy flag not available
    command(0x30);    //command 0x30 = Wake up #2
    Delay(10);        //must wait 160us, busy flag not available
    command(0x30);    //command 0x30 = Wake up #3
    Delay(10);        //must wait 160us, busy flag not available
    command(0x38);    //Function set: 8-bit/2-line
    command(0x10);    //Set cursor
    command(0x0c);    //Display ON; Cursor ON
    command(0x06);    //Entry mode set
}
/*****/
```



```

4-bit Initialization:
/*****/
void command(char i)
{
    P1 = i;                //put data on output Port
    D_I =0;                //D/I=LOW : send instruction
    R_W =0;                //R/W=LOW : Write
    Nybble();              //Send lower 4 bits
    i = i<<4;              //Shift over by 4 bits
    P1 = i;                //put data on output Port
    Nybble();              //Send upper 4 bits
}
/*****/
void write(char i)
{
    P1 = i;                //put data on output Port
    D_I =1;                //D/I=HIGH : send data
    R_W =0;                //R/W=LOW : Write
    Nybble();              //Clock lower 4 bits
    i = i<<4;              //Shift over by 4 bits
    P1 = i;                //put data on output Port
    Nybble();              //Clock upper 4 bits
}
/*****/
void Nybble()
{
    E = 1;
    Delay(1);              //enable pulse width >= 300ns
    E = 0;                 //Clock enable: falling edge
}
/*****/
void init()
{
    P1 = 0;
    P3 = 0;
    Delay(100);            //Wait >15 msec after power is applied
    P1 = 0x30;             //put 0x30 on the output port
    Delay(30);             //must wait 5ms, busy flag not available
    Nybble();              //command 0x30 = Wake up
    Delay(10);             //must wait 160us, busy flag not available
    Nybble();              //command 0x30 = Wake up #2
    Delay(10);             //must wait 160us, busy flag not available
    Nybble();              //command 0x30 = Wake up #3
    Delay(10);             //can check busy flag now instead of delay
    P1= 0x20;              //put 0x20 on the output port
    Nybble();              //Function set: 4-bit interface
    command(0x28);         //Function set: 4-bit/2-line
    command(0x10);         //Set cursor
    command(0x0F);         //Display ON; Blinking cursor
    command(0x06);         //Entry Mode set
}
/*****/

```

## 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 , 48hrs   | 2    |
| Low Temperature storage               | Endurance test applying the low storage temperature for a long time.  | -30°C , 48hrs   | 1,2  |
| High Temperature Operation            | Endurance test applying the electric stress (voltage & current) and the high thermal stress for a long time.                    | +70°C 48hrs   | 2    |
| Low Temperature Operation             | Endurance test applying the electric stress (voltage & current) and the low thermal stress for a long time.                     | -20°C , 48hrs   | 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 , 48hrs  | 1,2  |
| Thermal Shock resistance              | Endurance test applying the electric stress (voltage & current) during a cycle of low and high thermal stress.                  | 0°C,30min -> 25°C,5min -> 50°C,30min = 1 cycle<br>10 cycles                         |      |
| Vibration test                        | Endurance test applying vibration to simulate transportation and use.   | 10-55Hz , 15mm amplitude.<br>60 sec in each of 3 directions X,Y,Z<br>For 15 minutes | 3    |
| Static electricity test               | Endurance test applying electric static discharge.  | VS=800V, RS=1.5kΩ, CS=100pF<br>One time   |      |

**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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