

# NHD-0216K1Z-FSB-GBW-L

## Character Liquid Crystal Display Module

|       |                                |
|-------|--------------------------------|
| NHD-  | Newhaven Display               |
| 0216- | 2 lines x 16 characters        |
| K1Z-  | Model                          |
| F-    | Transflective                  |
| SB-   | Side Blue LED Backlight        |
| G-    | STN- Gray                      |
| B-    | 6:00 view                      |
| W-    | Wide Temperature (-20°C~+70°C) |
| L-    | Low Power 20mA                 |
|       | <b>RoHS Compliant</b>          |

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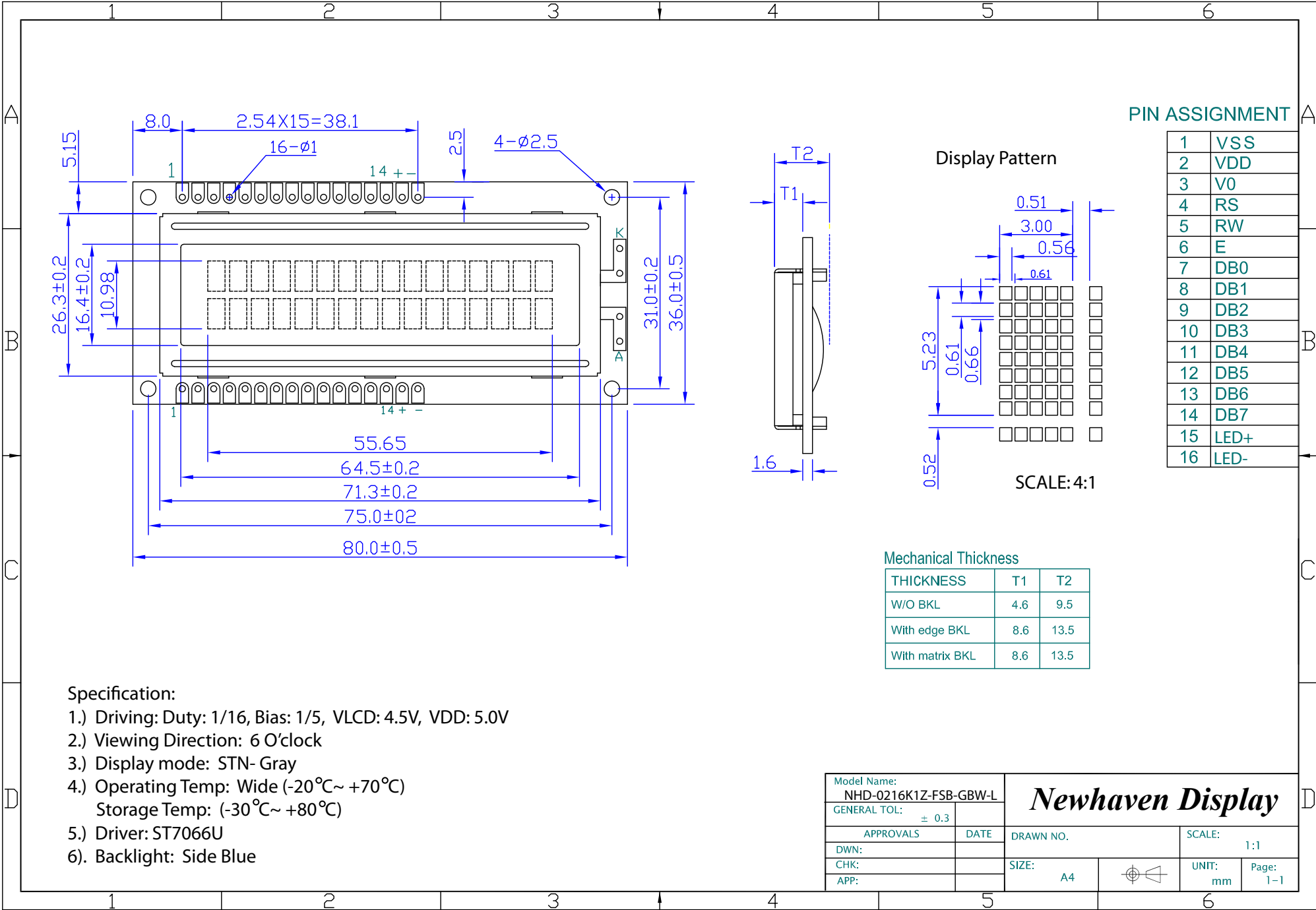
## Document Revision History

| Revision | Date       | Description                                  | Changed by |
|----------|------------|----------------------------------------------|------------|
| 0        | 10/5/2007  | Initial Release                              | -          |
| 1        | 10/9/2009  | User Guide Reformat                          | BE         |
| 2        | 12/11/2009 | Drawing, pin description, electrical updated | BE         |
| 3        | 12/16/2009 | Mechanical drawing updated                   | BE         |
| 4        | 1/7/2010   | Optical revised                              | BE         |
| 5        | 1/6/2011   | Alternate controller information updated     | AK         |
| 6        | 5/2/2011   | Electrical characteristics updated           | AK         |

## Functions and Features

- 2 lines x 16 characters
- Built-in controller (ST7066U)
- +5.0V Power Supply
- 1/16 duty, 1/5 bias
- RoHS compliant

Mechanical Drawing



## 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 (+5.0V)                                                                          |
| 3       | VO        | Adj Power Supply    | Power supply for contrast (approx. 0.4V)                                                                  |
| 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.                                                |
| 15      | LED+      | Power Supply        | Power supply for LED Backlight (+5.0V via on-board resistor)                                              |
| 16      | 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    |                   | 4.7     | 5.0  | 5.5  | V    |
| Supply Current              | IDD    | Ta=25°C, VDD=5.0V | -       | 1.5  | 2.5  | mA   |
| Supply for LCD (contrast)   | VDD-V0 | Ta=25°C           | -       | 4.6  | -    | V    |
| "H" Level input             | Vih    |                   | 0.7 VDD | -    | VDD  | V    |
| "L" Level input             | Vil    |                   | 0       | -    | 0.6  | V    |
| "H" Level output            | Voh    |                   | 3.9     | -    | -    | V    |
| "L" Level output            | Vol    |                   | -       | -    | 0.4  | V    |
|                             |        |                   |         |      |      |      |
| Backlight Supply Voltage    | Vled   | -                 | -       | 5.0  | -    | V    |
| Backlight Supply Current    | Iled   | Vled=5.0V         | -       | 20   | -    | 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 position DDRAM address

1 2 3 4 5 6 7 8 9 10 11 12

|    |    |    |    |    |    |    |    |    |    |    |    |  |  |  |  |
|----|----|----|----|----|----|----|----|----|----|----|----|--|--|--|--|
| 00 | 01 | 02 | 03 | 04 | 05 | 06 | 07 | 08 | 09 | 0A | 0B |  |  |  |  |
| 40 | 41 | 42 | 43 | 44 | 45 | 46 | 47 | 48 | 49 | 4A | 4B |  |  |  |  |

2-Line by 12-Character Display

## Command Table

| Instruction                | Instruction Code |     |     |     |     |     |     |     |     |     | Description                                                                                                                      | Description Time<br>(270KHz) |
|----------------------------|------------------|-----|-----|-----|-----|-----|-----|-----|-----|-----|----------------------------------------------------------------------------------------------------------------------------------|------------------------------|
|                            | RS               | R/W | DB7 | DB6 | DB5 | DB4 | DB3 | DB2 | DB1 | DB0 |                                                                                                                                  |                              |
| Clear Display              | 0                | 0   | 0   | 0   | 0   | 0   | 0   | 0   | 0   | 1   | Write "20H" to DDRAM. and set DDRAM address to "00H" from AC                                                                     | 1.52 ms                      |
| Return Home                | 0                | 0   | 0   | 0   | 0   | 0   | 0   | 0   | 1   | x   | Set DDRAM address to "00H" from AC and return cursor to its original position if shifted. The contents of DDRAM are not changed. | 1.52 ms                      |
| Entry Mode Set             | 0                | 0   | 0   | 0   | 0   | 0   | 0   | 1   | I/D | S   | Sets cursor move direction and specifies display shift. These operations are performed during data write and read.               | 37 us                        |
| Display ON/OFF             | 0                | 0   | 0   | 0   | 0   | 0   | 1   | D   | C   | B   | D=1:entire display on<br>C=1:cursor on<br>B=1:cursor position on                                                                 | 37 us                        |
| Cursor or Display Shift    | 0                | 0   | 0   | 0   | 0   | 1   | S/C | R/L | x   | x   | Set cursor moving and display shift control bit, and the direction, without changing DDRAM data.                                 | 37 us                        |
| Function Set               | 0                | 0   | 0   | 0   | 1   | DL  | N   | F   | x   | x   | DL:interface data is 8/4 bits<br>N:number of line is 2/1<br>F:font size is 5x11/5x8                                              | 37 us                        |
| Set CGRAM address          | 0                | 0   | 0   | 1   | AC5 | AC4 | AC3 | AC2 | AC1 | AC0 | Set CGRAM address in address counter                                                                                             | 37 us                        |
| Set DDRAM address          | 0                | 0   | 1   | AC6 | AC5 | AC4 | AC3 | AC2 | AC1 | AC0 | Set DDRAM address in address counter                                                                                             | 37 us                        |
| 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.           | 0 us                         |
| Write data to RAM          | 1                | 0   | D7  | D6  | D5  | D4  | D3  | D2  | D1  | D0  | Write data into internal RAM (DDRAM/CGRAM)                                                                                       | 37 us                        |
| Read data from RAM         | 1                | 1   | D7  | D6  | D5  | D4  | D3  | D2  | D1  | D0  | Read data from internal RAM (DDRAM/CGRAM)                                                                                        | 37 us                        |

## Built-in Font Table

| Lower 4 Bits \ Upper 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    |      |      |      | -    | 9    | ≡    | α    | p    |
| 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    | ハ    | 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    | ラ    | g    | π    |
| xxxx1000                    | (1)        |      | <    | 8    | H    | X    | h    | x    |      |      | イ    | ク    | ネ    | リ    | 、    | ⌘    |
| xxxx1001                    | (2)        |      | >    | 9    | I    | Y    | i    | y    |      |      | ウ    | ケ    | ル    | ル    | ´    | y    |
| xxxx1010                    | (3)        |      | *    | :    | J    | Z    | j    | z    |      |      | エ    | コ    | ハ    | レ    | j    | 千    |
| xxxx1011                    | (4)        |      | +    | ;    | K    | [    | k    | <    |      |      | オ    | サ    | ヒ    | ロ    | *    | 万    |
| xxxx1100                    | (5)        |      | ,    | <    | L    | ¥    | l    | l    |      |      | ヤ    | シ    | フ    | ワ    | ¢    | 円    |
| xxxx1101                    | (6)        |      | -    | =    | M    | ]    | m    | }    |      |      | ユ    | ズ    | ハ    | ン    | も    | ÷    |
| 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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