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# NHD-12232DZ-FSPG-GBW

## Graphic Liquid Crystal Display Module

|        |                                 |
|--------|---------------------------------|
| NHD-   | Newhaven Display                |
| 12232- | 122 x 32 pixels                 |
| DZ-    | Model                           |
| F-     | Transflective                   |
| SPG-   | Side Pure Green LED Backlight   |
| G-     | STN- Gray                       |
| B-     | 6:00 view                       |
| W-     | Wide Temperature (-20°C ~+70°C) |
|        | <b>RoHS Compliant</b>           |

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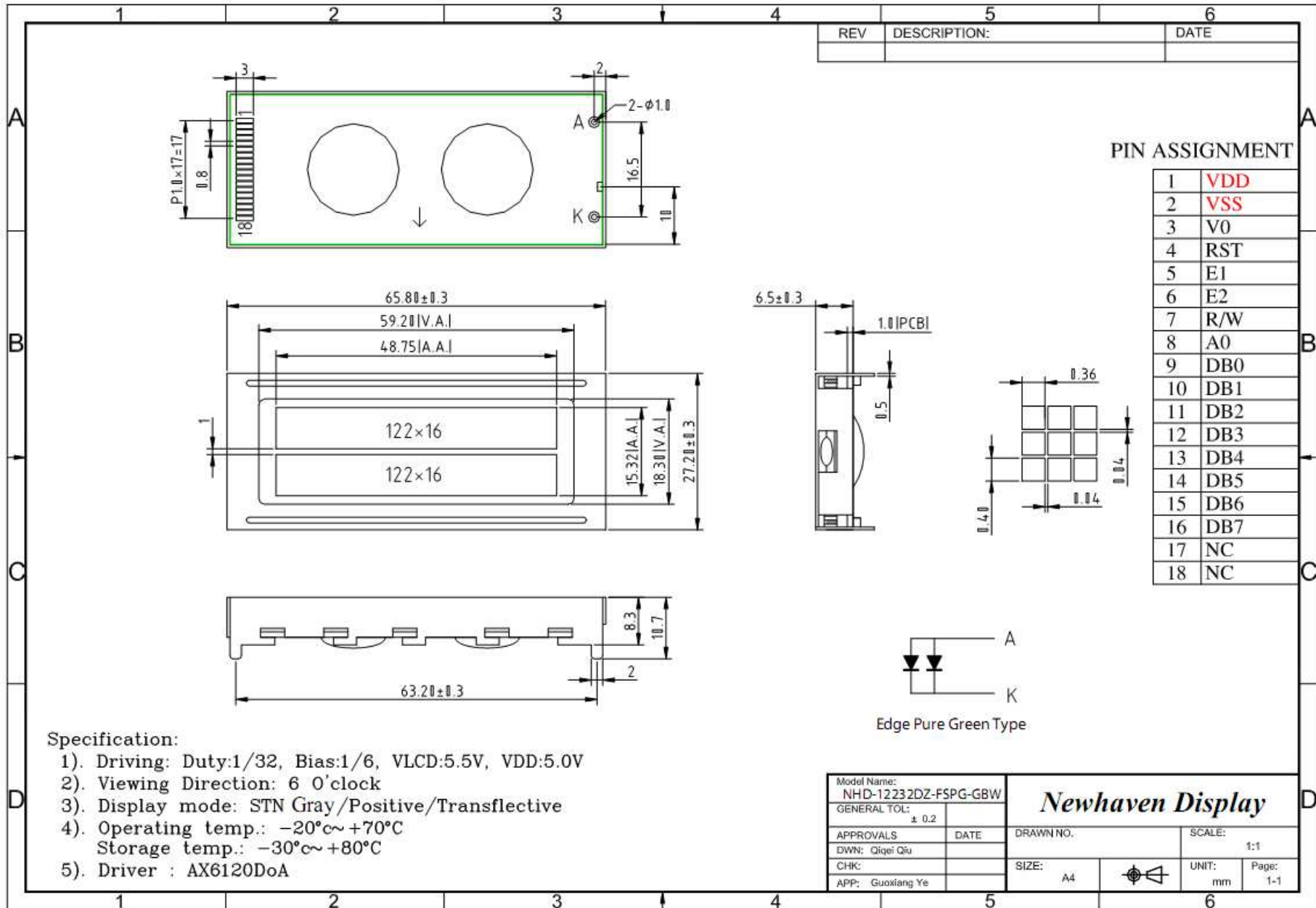
## Document Revision History

| Revision | Date      | Description             | Changed by |
|----------|-----------|-------------------------|------------|
| 0        | 5/19/2008 | Initial Release         | -          |
| 1        | 3/12/2010 | User guide reformat     | BE         |
| 2        | 4/14/2010 | Pin description updated | BE         |
|          |           |                         |            |

## Functions and Features

- 122 x 32 pixels
- Built-in AX6120 Controller
- +5.0V power supply
- 1/32 duty cycle; 1/6 bias
- RoHS Compliant

# Mechanical Drawing

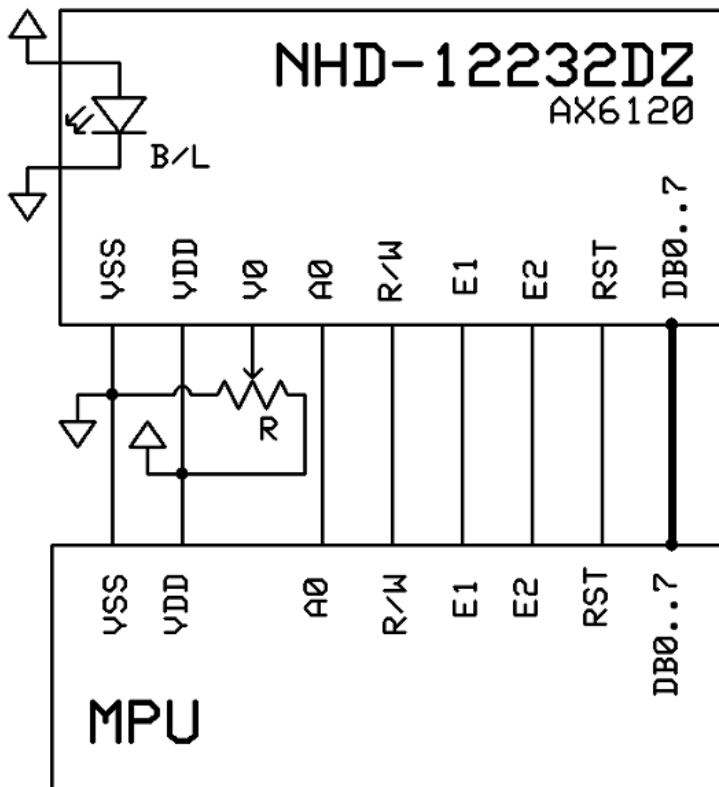


## Pin Description and Wiring Diagram

| Pin No. | Symbol  | External Connection | Function Description  |
|---------|---------|---------------------|---|
| 1       | VDD     | Power Supply        | Power supply for logic (+5.0V)                                |
| 2       | VSS     | Power Supply        | Ground  |
| 3       | V0      | Adj Power Supply    | Power supply for contrast (approx.- 0.5V)                     |
| 4       | RST     | MPU                 | Active low Reset  |
| 5       | E1      | MPU                 | Operation enable signal. Falling edge triggered, SEG (1~60)   |
| 6       | E2      | MPU                 | Operation enable signal. Falling edge triggered, SEG (61~120) |
| 7       | R/W     | MPU                 | Read/Write select signal, R/W=1: Read R/W: =0: Write          |
| 8       | A0      | MPU                 | Register select signal. A0=0: Command, A0=1: Data             |
| 9-16    | DB0-DB7 | MPU                 | This is an 8-bit bi-directional data bus                      |
| 17      | NC      | -                   | No Connect  |
| 18      | NC      | -                   | No Connect  |
| A       | LED+    | Power Supply        | Power supply for LED Backlight (+3.0V)                        |
| K       | LED-    | Power Supply        | Ground for Backlight  |

Recommended LCD connector: 1.0mm 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 | -    | 1.2  | 1.5  | mA   |
| Supply for LCD (contrast)   | VDD-V0 | Ta=25°C           | -    | 5.5  | -    | V    |
| "H" Level input             | VIH    |                   | 2.2  | -    | VDD  | V    |
| "L" Level input             | VIL    | -                 | 0    | -    | 0.6  | V    |
| "H" Level output            | VOH    | -                 | 2.4  | -    | -    | V    |
| "L" Level output            | VOL    | -                 | -    | -    | 0.4  | V    |
|                             |        |                   |      |      |      |      |
| Backlight Supply Voltage    | VLED   |                   | -    | 3.0  | -    | V    |
| Backlight Supply Current    | ILED   | VLED=3.0V         | -    | 36   | -    | mA   |

## Optical Characteristics

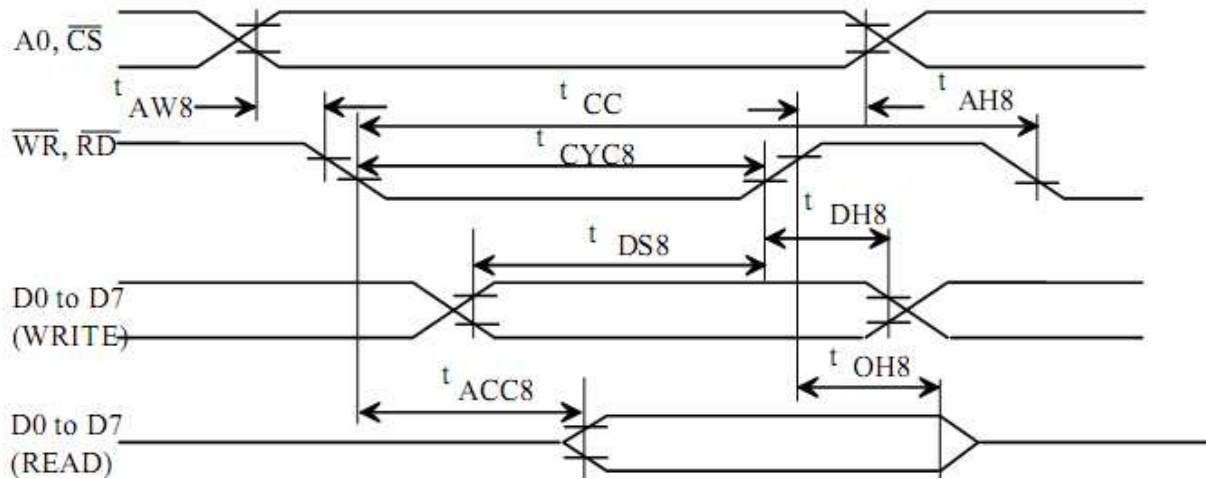
| Item                               | Symbol | Condition | Min. | Typ. | Max. | Unit |
|------------------------------------|--------|-----------|------|------|------|------|
| Viewing Angle - Vertical (top)     | AV     | Cr ≥ 3    | -    | 10   | -    |      |
| Viewing Angle – Vertical (bottom)  | AV     | Cr ≥ 3    | -    | 60   | -    | °    |
| Viewing Angle – Horizontal (left)  | AH     | Cr ≥ 3    | -    | 45   | -    |      |
| Viewing Angle - Horizontal (right) | AH     | Cr ≥ 3    | -    | 45   | -    | °    |
| Contrast Ratio                     | Cr     |           | -    | 5    | -    | -    |
| Response Time (rise)               | Tr     | -         | -    | 100  | 150  | ms   |
| Response Time (fall)               | Tf     | -         | -    | 150  | 200  | ms   |

## Controller Information

Built-in AX6120. Download specification at [http://www.newhavendisplay.com/app\\_notes/AX6120.pdf](http://www.newhavendisplay.com/app_notes/AX6120.pdf)

## Timing Characteristics

- MPU Bus Read/Write i (80-family MPU)



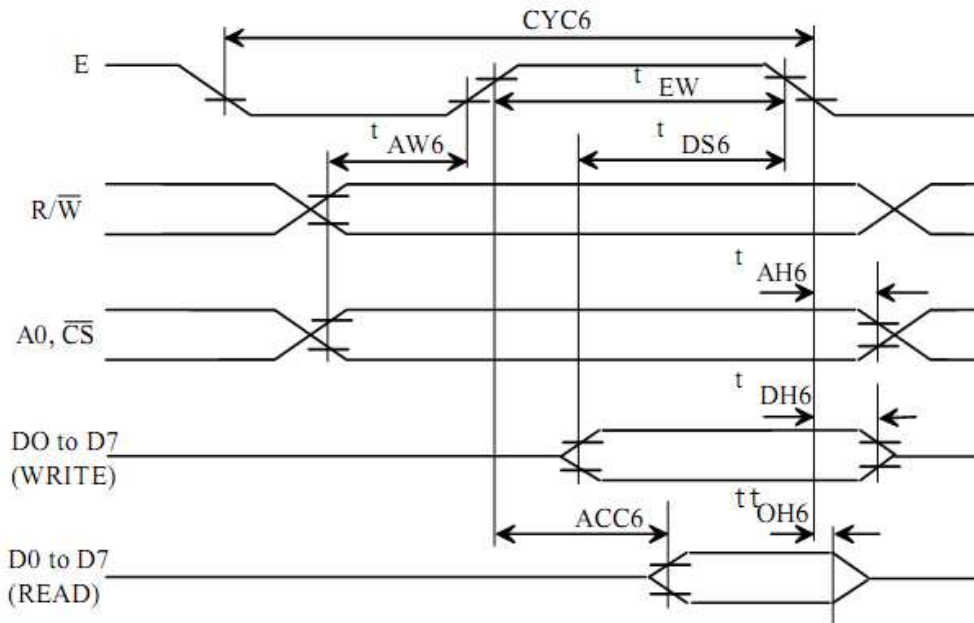
$T_a = -20$  to  $75$  deg. C,  $V_{ss} = -1.0 \pm 10\%$  unless stated otherwise

| Parameter           | Symbol     | Condition  | Rating |     | Unit | Signal   |
|---------------------|------------|------------|--------|-----|------|----------|
|                     |            |            | min    | max |      |          |
| Address hold time   | $t_{AH8}$  |            | 10     | --  | ns   | A0, CS   |
| Address setup time  | $t_{AW8}$  |            | 20     | --  | ns   |          |
| System cycle time   | $t_{CYC8}$ |            | 1,000  | --  | ns   | WR, RD   |
| Control pulsewidth  | $t_{CC}$   |            | 200    | --  | ns   |          |
| Data setup time     | $t_{DS8}$  |            | 80     | --  | ns   | D0 to D7 |
| Data hold time      | $t_{DH8}$  |            | 10     | --  | ns   |          |
| RD access time      | $t_{ACC8}$ | CL = 100pF | --     | 90  | ns   |          |
| Output disable time | $t_{CH8}$  |            | 10     | 60  | ns   |          |

Notes : 1. Increase parameter values by 200% when  $V_{ss} = -3.0V$ .

2. All inputs must have a rise and fall time of less than 15 ns.

• MPU Bus Read/Write II (68-family MPU)



Ta= -20 to 75 deg. C. Vss= -5V ± 10 unless stated otherwise

| Parameter           | Symbol | Condition | Rating |     | Unit | Signal                                  |
|---------------------|--------|-----------|--------|-----|------|---|
|                     |        |           | min    | max |      |   |
| System cycle time   | tCYC6  |           | 1,000  | --  | ns   | A0, $\overline{CS}$ , R/ $\overline{W}$ |
| Address setup time  | tAW6   |           | 20     | --  | ns   |   |
| Address hold time   | tAH6   |           | 10     | --  | ns   |   |
| Data setup time     | tDS6   |           | 80     | --  | ns   | D0 to D7                                |
| Data hold time      | tDH6   |           | 10     | --  | ns   |   |
| Output disable time | tOH6   |           | 10     | 60  | ns   |   |
| Access time         | tACC6  | CL= 100pF | --     | 90  | ns   |   |
| Enable pulsewidth   | Read   | tEW       | 100    | --  | ns   | E                                       |
|                     | Write  |           | 8      | --  | ns   |   |

Notes : 1. tCYC6 is the cycle time of CS. E=H. not the cycle time of E.

2. Increase parameter values by 200% when Vss= -3.0V.

3. all inputs must have a rise and fall time of less than 15 ns.



## Table of Commands

| Command                      | Code |                 |                 |            |                          |        |                                 |    |    |               |   | Function   |
|------------------------------|------|-----------------|-----------------|------------|--------------------------|--------|---------------------------------|----|----|---------------|---|--|
|                              | A0   | $\overline{RD}$ | $\overline{WR}$ | D7         | D6                       | D5     | D4                              | D3 | D2 | D1            | D0  |  |
| Display On/Off               | 0    | 1               | 0               | 1          | 0                        | 1      | 0                               | 1  | 1  | 1             | 0/1   | Turns display on or off.<br>1 : ON, 0 : OFF  |
| Display start line           | 0    | 1               | 0               | 1          | 1                        | 0      | Display start address (0 to 31) |    |    |               | Specifies RAM line corresponding to top line of display.    |  |
| Set page address             | 0    | 1               | 0               | 1          | 0                        | 1      | 1                               | 1  | 0  | Page (0 to 3) |   | Sets display RAM page in page address register.  |
| Set column (segment) address | 0    | 1               | 0               | 0          | Column address (0 to 79) |        |                                 |    |    |               | Sets display RAM column address in column address register. |  |
| Read status                  | 0    | 0               | 1               | Busy       | ADC                      | ON/OFF | Reset                           | 0  | 0  | 0             | 0   | Reads the following status :<br>BUSY 1 : Busy<br>0 : Ready<br>ADC 1 : CW output<br>0 : CCW output<br>ON/OFF 1 : Display off<br>0 : Display on<br>RESET 1 : Being reset<br>0 : Normal |
| Write display data           | 1    | 1               | 0               | Write data |                          |        |                                 |    |    |               | Writes data from data bus into display RAM.                 |  |
| Read display data            | 1    | 0               | 1               | Read data  |                          |        |                                 |    |    |               | Reads data from display RAM onto data bus.                  |  |
| Select ADC                   | 0    | 1               | 0               | 1          | 0                        | 1      | 0                               | 0  | 0  | 0             | 0/1   | 0 : CW output, 1 : CCW output  |
| Static drive ON/OFF          | 0    | 1               | 0               | 1          | 0                        | 1      | 0                               | 0  | 1  | 0             | 0/1   | Selects static driving operation.<br>1 : Static drive, 0 : Normal driving  |
| Select duty                  | 0    | 1               | 0               | 1          | 0                        | 1      | 0                               | 1  | 0  | 0             | 0/1   | Selects LCD duty cycle<br>1 : 1/32, 0 : 1/16   |
| Read-Modify-Write            | 0    | 1               | 0               | 1          | 1                        | 1      | 0                               | 0  | 0  | 0             | 0   | Read-modify-write ON   |
| End                          | 0    | 1               | 0               | 1          | 1                        | 1      | 0                               | 1  | 1  | 1             | 0   | Read-modify-write OFF  |
| Reset                        | 0    | 1               | 0               | 1          | 1                        | 1      | 0                               | 0  | 0  | 1             | 0   | Software reset   |

## Example Initialization Program:

```
/******  
void Comleft(char i)  
{  
  P1 = i;  
  R_W = 0;  
  D_I = 0;  
  E1 = 1;  
  delay(2);  
  E1 = 0;  
}  
  
void Comright(char i)  
{  
  P1 = i;  
  R_W = 0;  
  D_I = 0;  
  E2 = 1;  
  delay(2);  
  E2 = 0;  
}  
  
void Writeleft(char i)  
{  
  P1 = i;  
  R_W = 0;  
  D_I = 1;  
  E1 = 1;  
  delay(2);  
  E1 = 0;  
}  
  
void Writerright(char i)  
{  
  P1 = i;  
  R_W = 0;  
  D_I = 1;  
  E2 = 1;  
  delay(2);  
  E2 = 0;  
}  
/******  
void bothSides(char i)  
{  
  Comleft(i);  
  Comright(i);  
}  
/******  
  
void init()  
{  
  P1 = 0;  
  P3 = 0;  
  RST = 0; //      Reset RST  
  delay(1);  
  RST = 1; //      Reset RST= M68 Interface  
  delay(10);  
  D_I = 0;  
  E1 = 1;  
  E2 = 1;  
  R_W = 1;  
  
  bothSides(0xE2);  
  delay(10);  
  bothSides(0xA4);  
  bothSides(0xA9);  
  bothSides(0xA0);  
  bothSides(0xEE);  
  bothSides(0xC0);  
  bothSides(0xAF);  
}  
/******
```

## 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 , 200hrs  | 2    |
| Low Temperature storage               | Endurance test applying the low storage temperature for a long time.  | -30°C , 200hrs  | 1,2  |
| High Temperature Operation            | Endurance test applying the electric stress (voltage & current) and the high thermal stress for a long time.                    | +70°C 200hrs  | 2    |
| Low Temperature Operation             | Endurance test applying the electric stress (voltage & current) and the low thermal stress for a long time.                     | -20°C , 200hrs  | 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. | +60°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 -> 25°C,5min -> 70°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)