# NHD-0212WH-ATGH-JT#

## Character Liquid Crystal Display Module

| | |
|---|---|
| NHD- | Newhaven Display |
| 0212- | 2 lines x 12 characters |
| WH- | Display Type: Character |
| A- | Model |
| T- | White LED Backlight |
| G- | STN- Gray |
| H- | Transflective, 6:00 view, Wide Temp. (-20°C~+70°C) |
| JT#- | English/Japanese standard font |
| | **RoHS Compliant** |


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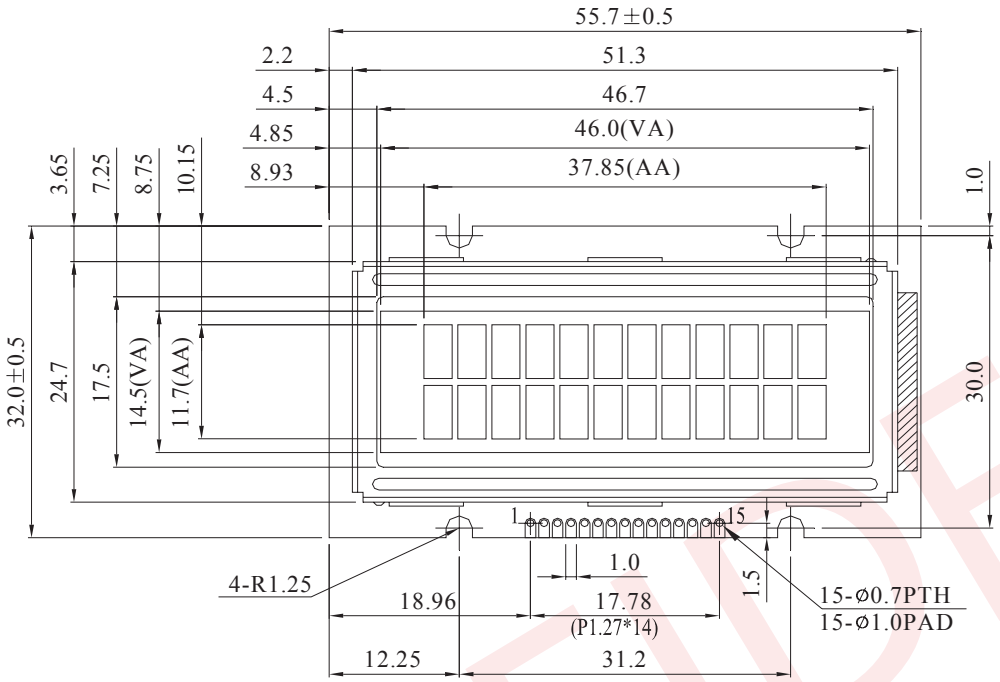
## Document Revision History

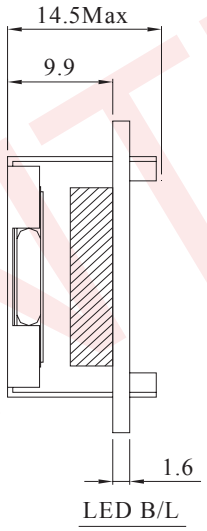
| Revision | Date | Description | Changed by |
|---|---|---|---|
| **0** | **7/16/2007** | **Initial Release** | **-** |
| 1 | **11/5/2009** | **User Guide Reformat** | **BE** |
| 2 | **1/5/2010** | **Optical revised** | **BE** |
| 3 | **10/4/2010** | **Mechanical drawing revised** | **BE** |
| 4 | **1/6/2011** | **Alternate controller information updated** | **AK** |
| 5 | **10/11/2011** | **Electrical characteristics updated** | **AK** |
| 6 | **4/10/2013** | **Mechanical drawing, Optical characteristics updated** | **AK** |

## Functions and Features

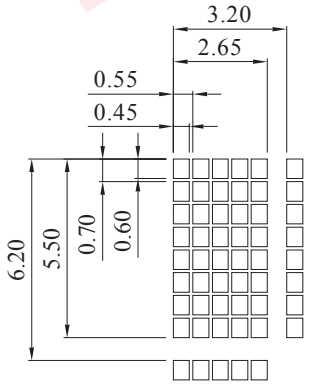
- **2 lines x 12 characters**
- **Built-in controller (ST7066)**
- **+5.0V Power Supply**
- **1/16 duty, 1/5 bias**
- **RoHS compliant**

# Mechanical Drawing




| PIN NO. | SYMBOL |
|---|---|
| 1 | VSS |
| 2 | VDD |
| 3 | V0 |
| 4 | RS |
| 5 | R/W |
| 6 | E |
| 7 | DB0 |
| 8 | DB1 |
| 9 | DB2 |
| 10 | DB3 |
| 11 | DB4 |
| 12 | DB5 |
| 13 | DB6 |
| 14 | DB7 |
| 15 | A |




| Rev | Description | Date |
|---|---|---|
| | | |

| | Date | |
|---|---|---|
| | 04/10/13 | NEWHAVEN DISPLAY INTERNATIONAL |
| Gen. Tolerance ±0.3mm | Unit mm | Model: NHD-0212WH-ATGH-JT# |

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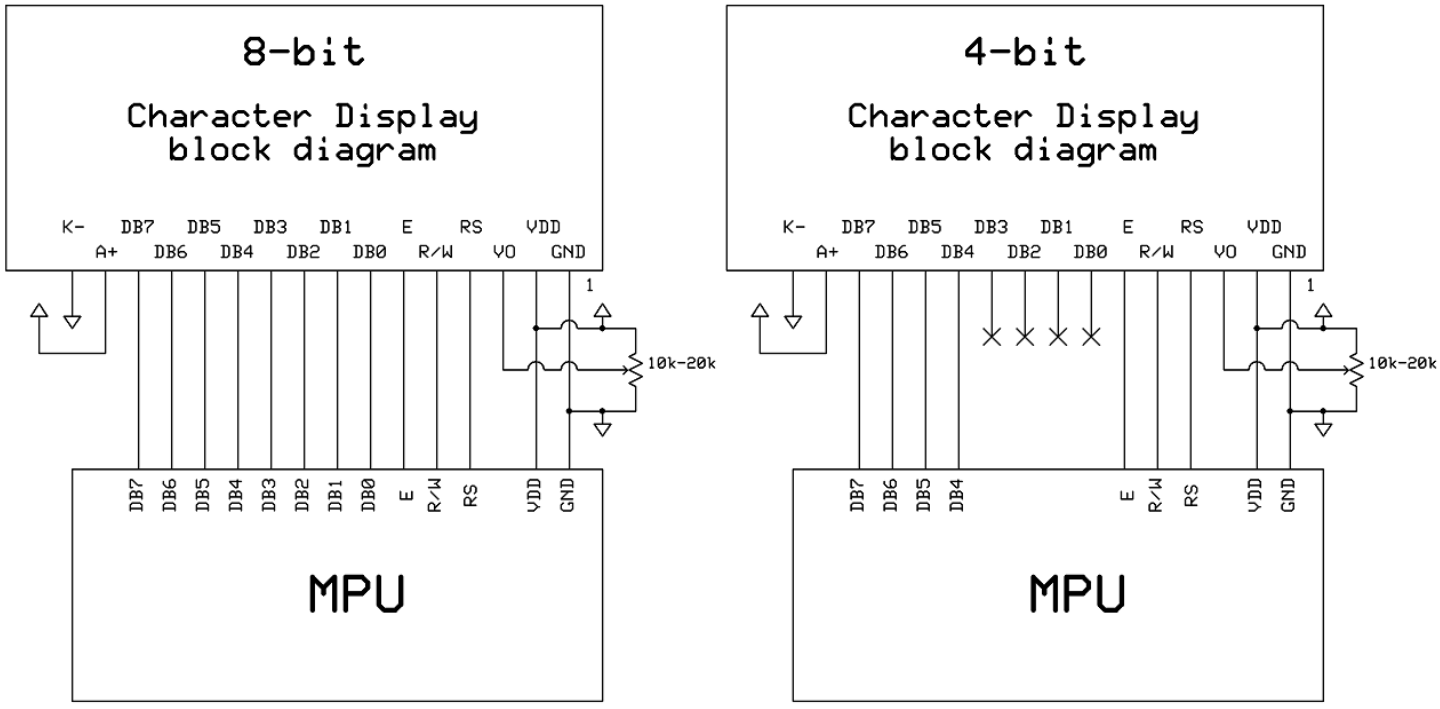
## Pin Description and Wiring Diagram

| Pin No. | Symbol | External Connection | Function Description |
|---|---|---|---|
| 1 | VSS | Power Supply | Ground |
| 2 | VDD | Power Supply | Supply Voltage for logic (+5.0V) |
| 3 | V0 | Adj Power Supply | Power supply for contrast (approx. 0.8V) |
| 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 | A | Power Supply | Power supply for LED Backlight (+3.5V) |

**Recommended LCD connector:** 1.27mm 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 | | 4.5 | 5.0 | 5.5 | V |
| Supply Current | IDD | Ta=25°C, VDD=5.0V | - | 1.2 | - | mA |
| Supply for LCD (contrast) | VDD-V0 | Ta=25°C | 3.5 | 4.2 | 5.7 | V |
| "H" Level input | Vih | | 0.7*VDD | - | VDD | V |
| "L" Level input | Vil | | VSS | - | 0.6 | V |
| "H" Level output | Voh | | 3.9 | - | VDD | V |
| "L" Level output | Vol | | - | - | 0.4 | V |
| | | | | | | |
| Backlight Supply Voltage | Vled | - | 3.4 | 3.5 | 3.6 | V |
| Backlight Supply Current | Iled | Vled=3.5V | 16 | 20 | 30 | mA |

## Optical Characteristics

| Item | Symbol | Condition | Min. | Typ. | Max. | Unit |
|---|---|---|---|---|---|---|
| Viewing Angle – Top | | Cr ≥ 2 | - | 20 | - | º |
| Viewing Angle – Bottom | | | - | 40 | - | º |
| Viewing Angle – Left | | | - | 30 | - | º |
| Viewing Angle – Right | | | - | 30 | - | º |
| Contrast Ratio | Cr | | - | 3 | - | - |
| Response Time (rise) | Tr | - | - | 150 | 200 | ms |
| Response Time (fall) | Tf | - | - | 150 | 200 | ms |

## Controller Information

Built-in ST7066 controller.
Please download specification at http://www.newhavendisplay.com/app_notes/ST7066U.pdf

## DDRAM Character Address

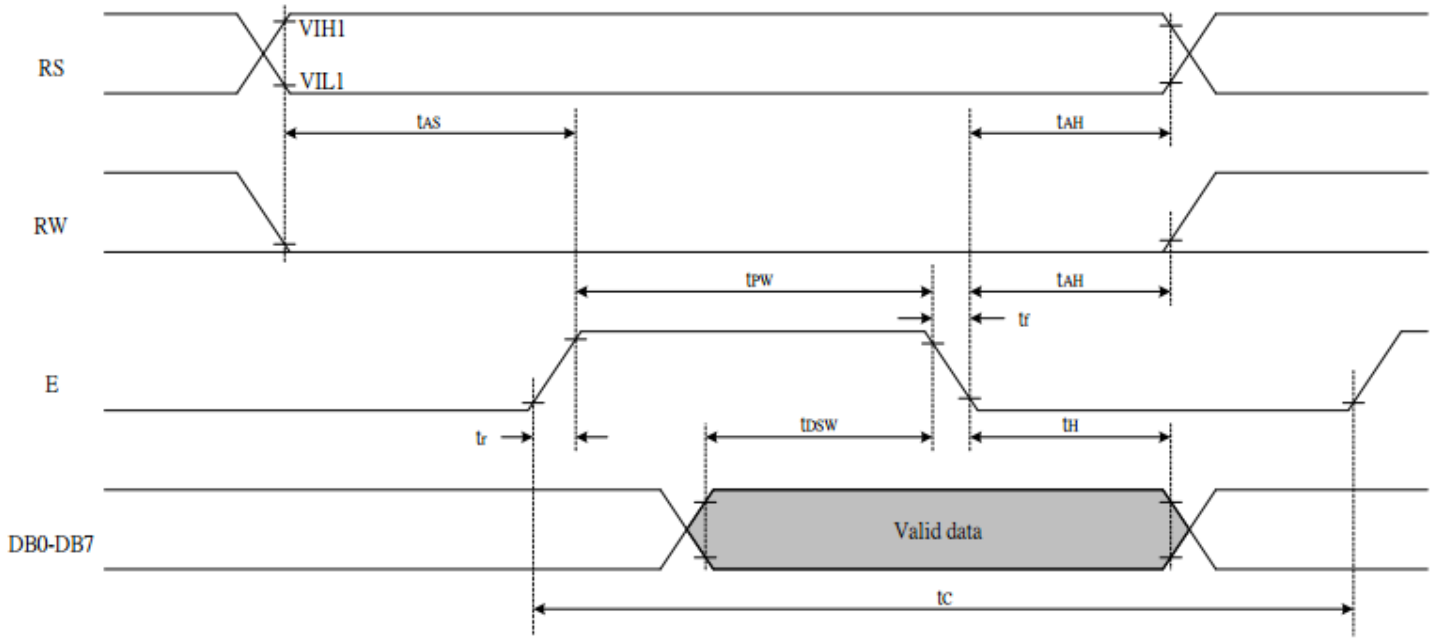
| 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 00 | 01 | 02 | 03 | 04 | 05 | 06 | 07 | 08 | 09 | 0A | 0B |
| 40 | 41 | 42 | 43 | 44 | 45 | 46 | 47 | 48 | 49 | 4A | 4B |

## Table of Commands

| Instruction | Instruction Code | | | | | | | | | | Description | Description Time (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 |

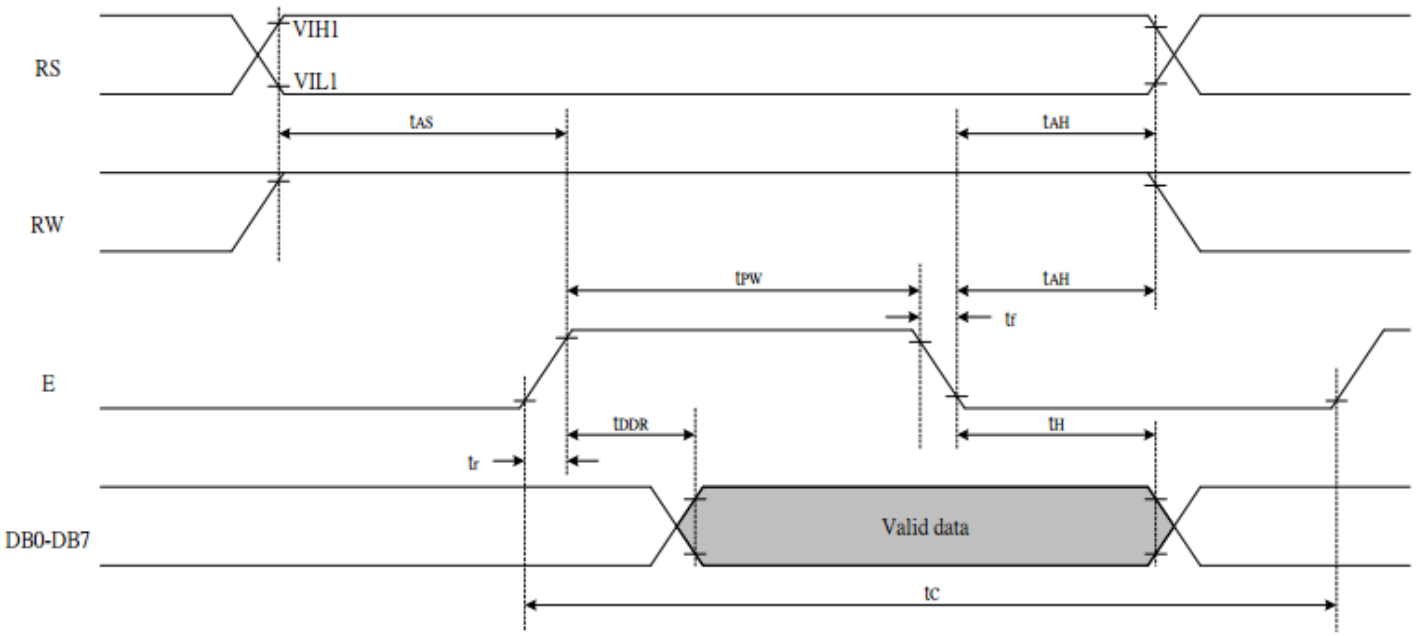
## Timing Characteristics

### Writing data from MPU to ST7066U




| *Write Mode (Writing data from MPU to ST7066U)* | | | | | | |
|---|---|---|---|---|---|---|
| $T_C$ | Enable Cycle Time | Pin E | 1200 | - | - | ns |
| $T_{PW}$ | Enable Pulse Width | Pin E | 460 | - | - | ns |
| $T_R, T_F$ | Enable Rise/Fall Time | Pin E | - | - | 25 | ns |
| $T_{AS}$ | Address Setup Time | Pins: RS,RW,E | 0 | - | - | ns |
| $T_{AH}$ | Address Hold Time | Pins: RS,RW,E | 10 | - | - | ns |
| $T_{DSW}$ | Data Setup Time | Pins: DB0 - DB7 | 80 | - | - | ns |
| $T_H$ | Data Hold Time | Pins: DB0 - DB7 | 10 | - | - | ns |

**Reading data from ST7066U to MPU**




| *Read Mode (Reading Data from ST7066U to MPU)* | | | | | | |
|---|---|---|---|---|---|---|
| $T_C$ | Enable Cycle Time | Pin E | 1200 | - | - | ns |
| $T_{PW}$ | Enable Pulse Width | Pin E | 480 | - | - | ns |
| $T_R$,$T_F$ | Enable Rise/Fall Time | Pin E | - | - | 25 | ns |
| $T_{AS}$ | Address Setup Time | Pins: RS,RW,E | 0 | - | - | ns |
| $T_{AH}$ | Address Hold Time | Pins: RS,RW,E | 10 | - | - | ns |
| $T_{DDR}$ | Data Setup Time | Pins: DB0 - DB7 | - | - | 320 | ns |
| $T_H$ | Data Hold Time | Pins: DB0 - DB7 | 10 | - | - | ns |

## Built-in Font Table

## 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=HIGH : 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 >40 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 >40 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

## Warranty Information and Terms & Conditions

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

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- Подбор аналогов;
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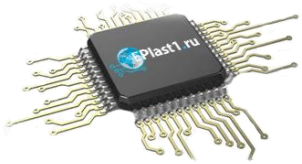
- Техническая поддержка проекта;
- Защита от снятия компонента с производства.




**Как с нами связаться**

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