

NHD-0220WH-MTFH-JT#E

Character Liquid Crystal Display Module

| | |
|-------|--|
| NHD- | Newhaven Display |
| 0220- | 2 lines x 20 characters |
| WH- | Display Type: Character |
| M- | Model |
| T- | White LED Backlight |
| F- | FSTN (+) White |
| H- | Transflective, 6:00 view, Wide Temperature (-20°C~+70°C) |
| JT#- | English and Japanese standard font |
| E- | ESD Protection |
| | RoHS Compliant |

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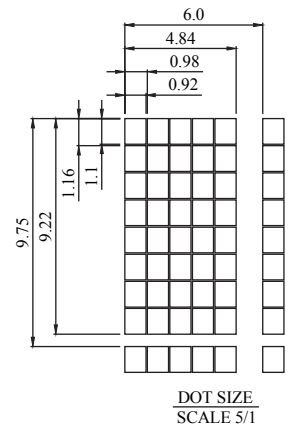
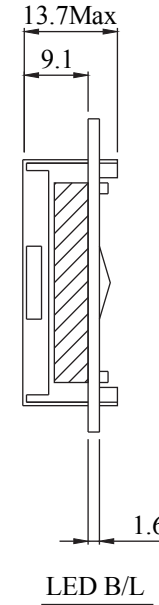
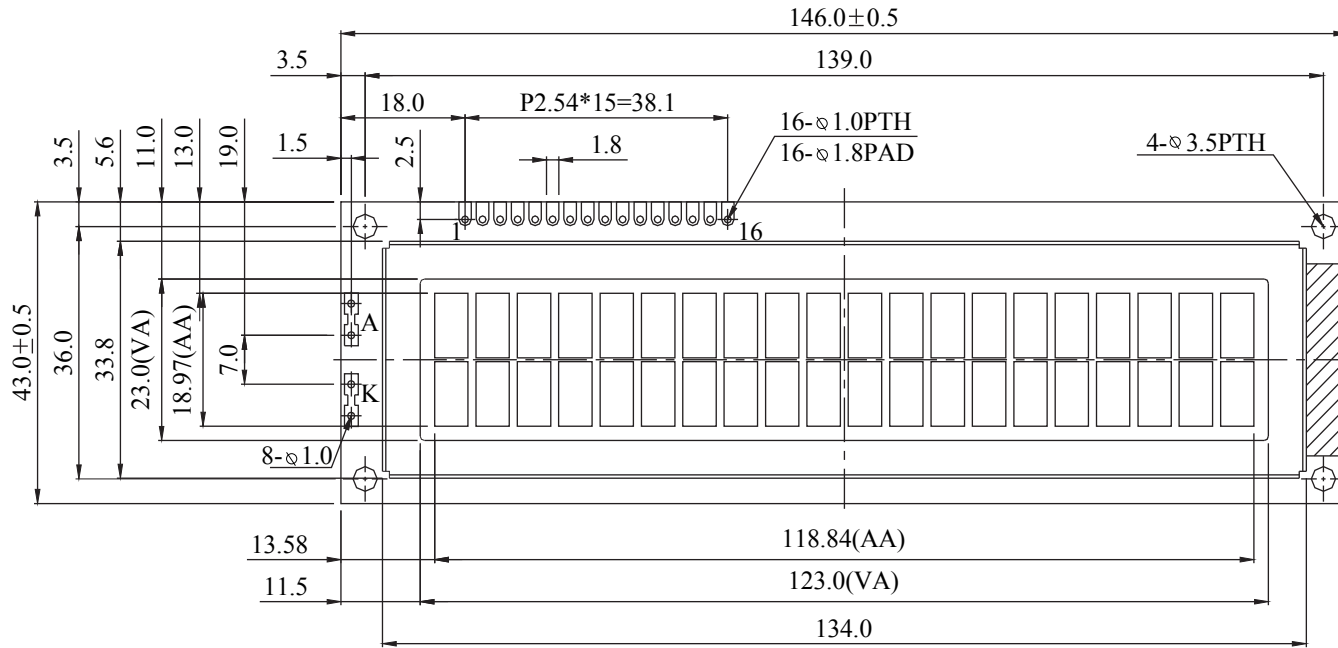
Document Revision History

| Revision | Date | Description | Changed by |
|----------|-----------|--|------------|
| 0 | 3/27/2007 | Initial Release | - |
| 1 | 7/6/2010 | User Guide Reformat | MC |
| 2 | 9/24/2010 | P/N Change. Part now has ESD Protection | MC |
| 3 | 3/1/2011 | Alternate controller information updated | AK |

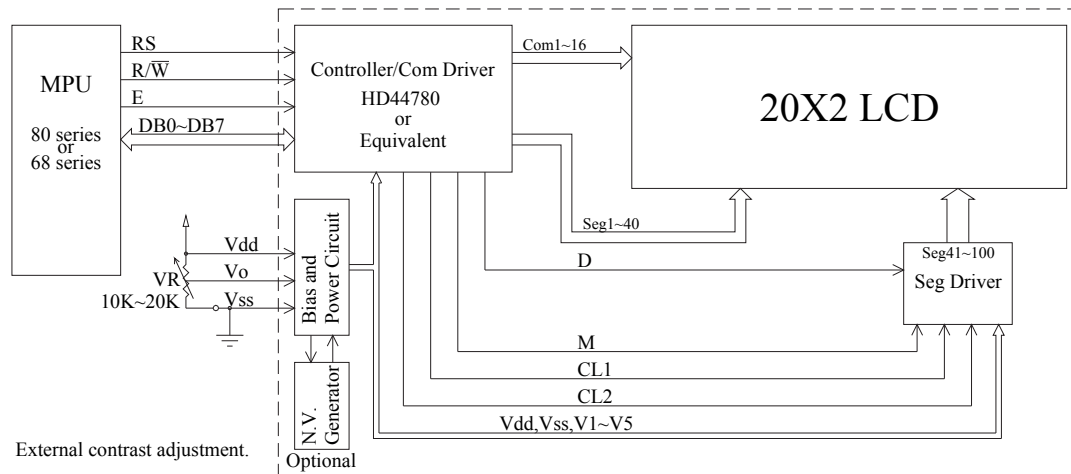
Functions and Features

- 2 lines x 20 characters
- Built-in controller (KS0066U or ST7066U)
- +5.0V Power Supply
- 1/16 duty, 1/5 bias
- RoHS compliant

Mechanical Drawing



| PIN NO. | SYMBOL |
|---------|--------|
| 1 | Vss |
| 2 | Vdd |
| 3 | Vo |
| 4 | RS |
| 5 | R/W |
| 6 | E |
| 7 | DB0 |
| 8 | DB1 |
| 9 | DB2 |
| 10 | DB3 |
| 11 | DB4 |
| 12 | DB5 |
| 13 | DB6 |
| 14 | DB7 |
| 15 | LED+ |
| 16 | LED- |



Newhaven Display

Part No.

NHD-0220WH-MTFH-JT#E

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. 0.5V) |
| 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 (+3.5V) |
| 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 | | 4.5 | 5.0 | 5.5 | V |
| Supply Current | IDD | Ta=25°C, VDD=5.0V | 1.0 | 1.2 | 1.5 | mA |
| Supply for LCD (contrast) | VDD-V0 | Ta=25°C | 3.8 | 4.5 | 5.5 | V |
| "H" Level input | Vih | | 0.7VDD | - | VDD | V |
| "L" Level input | Vil | | VSS | - | 0.6 | V |
| "H" Level output | Voh | | 3.9 | - | - | 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 | 44 | 48 | 75 | mA |
| Backlight Lifetime | - | Iled=48mA | - | 50,000 | - | Hrs. |

Optical Characteristics

| Item | Symbol | Condition | Min. | Typ. | Max. | Unit |
|------------------------------------|--------|-----------|------|------|------|------|
| Viewing Angle – Vertical (top) | AV | Cr ≥ 3 | - | 20 | - | ° |
| Viewing Angle – Vertical (bottom) | AV | Cr ≥ 3 | - | 50 | - | ° |
| Viewing Angle – Horizontal (left) | AH | Cr ≥ 3 | - | 30 | - | ° |
| Viewing Angle – Horizontal (right) | AH | Cr ≥ 3 | - | 30 | - | ° |
| Contrast Ratio | Cr | | 3 | 5 | - | - |
| Response Time (rise) | Tr | - | - | 150 | 250 | ms |
| Response Time (fall) | Tf | - | - | 150 | 250 | ms |

Controller Information

Built-in KS0066U. Download specification at http://www.newhavendisplay.com/app_notes/KS0066U.pdf

Built-in ST7066U. Download specification at http://www.newhavendisplay.com/app_notes/ST7066U.pdf

Table of Commands

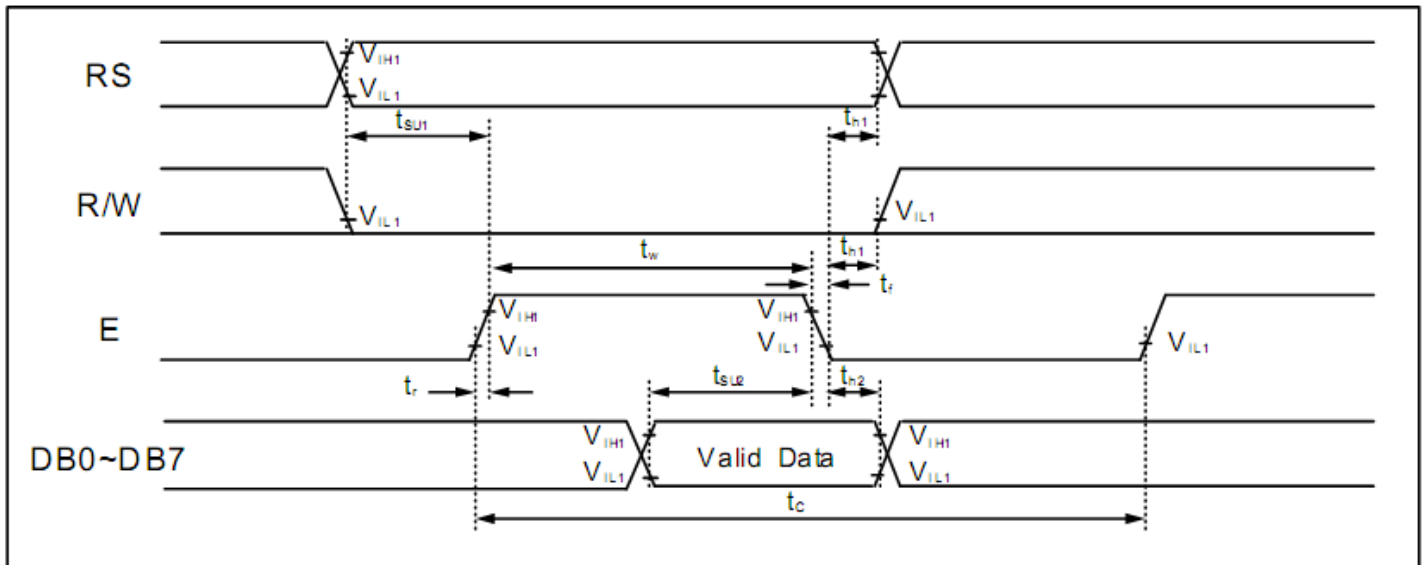
| Instruction | Instruction Code | | | | | | | | | | Description | Execution time (fosc=270KHz) |
|------------------------------------|------------------|-----|-----|-----|-----|-----|-----|-----|-----|-----|--|---------------------------------|
| | RS | R/W | DB7 | DB6 | DB5 | DB4 | DB3 | DB2 | DB1 | 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 | 1.52ms |
| Return Home | 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. | 1.52ms |
| Entry Mode Set | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | I/D | S | Assign cursor moving direction and enable the shift of entire display | 38μs |
| Display ON/OFF Control | 0 | 0 | 0 | 0 | 0 | 0 | 1 | D | C | B | Set display(D), cursor(C), and blinking of cursor(B) on/off control bit. | 38μs |
| Cursor or Display Shift | 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. | 38μs |
| Function Set | 0 | 0 | 0 | 0 | 1 | DL | N | F | - | - | Set interface data length (DL: 8bit/4-bit), numbers of display line (N: 2-line/1-line) and, display font type (F:5x10 dots/5x8 dots) | 38μs |
| Set CGRAM Address | 0 | 0 | 0 | 1 | AC5 | AC4 | AC3 | AC2 | AC1 | AC0 | Set CGRAM address in address counter. | 38μs |
| Set DDRAM Address | 0 | 0 | 1 | AC6 | AC5 | AC4 | AC3 | AC2 | AC1 | AC0 | Set DDRAM address in counter | 38μs |
| Read Busy Flag and Address Counter | 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. | |
| Write Data to RAM | 1 | 0 | D7 | D6 | D5 | D4 | D3 | D2 | D1 | D0 | Write data into internal RAM (DDRAM/CGRAM). | 38μs |
| Read Data from RAM | 1 | 1 | D7 | D6 | D5 | D4 | D3 | D2 | D1 | D0 | Read data from internal RAM (DDRAM/CGRAM). | 38μs |

Display character address code:

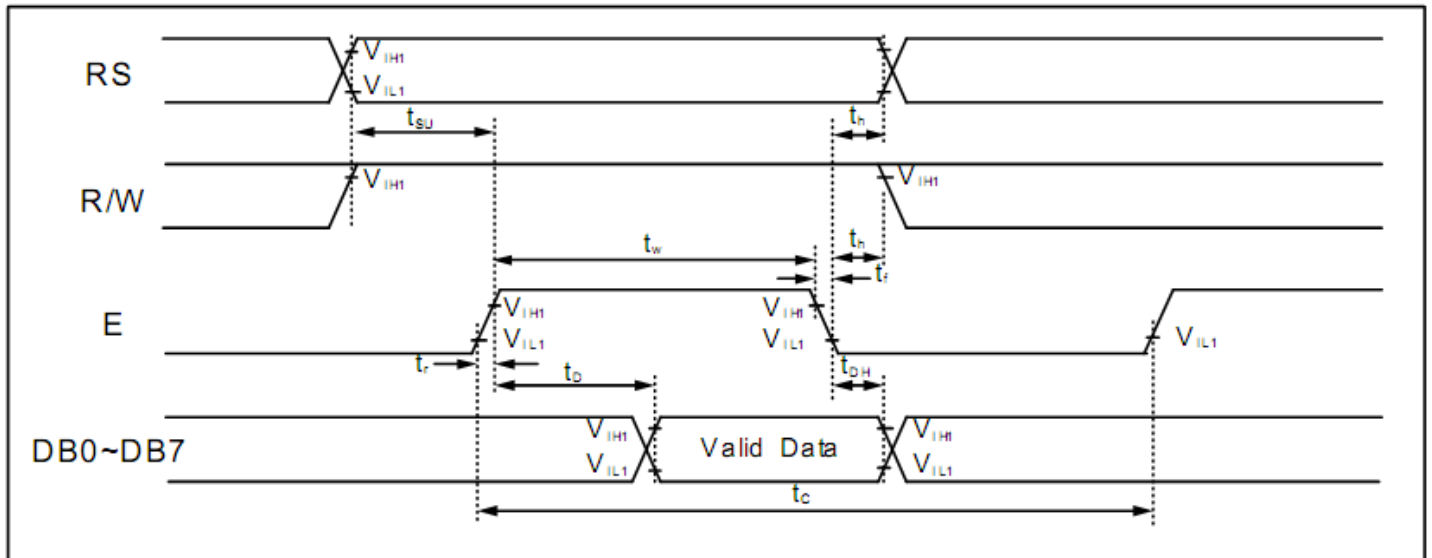
| 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | 14 | 15 | 16 | 17 | 18 | 19 | 20 |
|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|
| 00 | 01 | 02 | 03 | 04 | 05 | 06 | 07 | 08 | 09 | 0A | 0B | 0C | 0D | 0E | 0F | 20 | 21 | 22 | 23 |
| 40 | 41 | 42 | 43 | 44 | 45 | 46 | 47 | 48 | 49 | 4A | 4B | 4C | 4D | 4E | 4F | 50 | 51 | 52 | 53 |

Timing Characteristics

Write Mode Timing Diagram



Read Mode Timing Diagram



| Mode | Characteristic | Symbol | Min. | Typ. | Max. | Unit |
|--------------------------------|---------------------------|-------------|------|------|------|------|
| Write Mode (Refer to Fig-6) | E Cycle Time | t_c | 500 | - | - | ns |
| | E Rise / Fall Time | t_{R,t_F} | - | - | 20 | |
| | E Pulse Width (High, Low) | t_w | 230 | - | - | |
| | R/W and RS Setup Time | t_{su1} | 40 | - | - | |
| | R/W and RS Hold Time | t_{H1} | 10 | - | - | |
| | Data Setup Time | t_{su2} | 80 | - | - | |
| | Data Hold Time | t_{H2} | 10 | - | - | |
| Read Mode (Refer to Fig-7) | E Cycle Time | t_c | 500 | - | - | ns |
| | E Rise / Fall Time | t_{R,t_F} | - | - | 20 | |
| | E Pulse Width (High, Low) | t_w | 230 | - | - | |
| | R/W and RS Setup Time | t_{su} | 40 | - | - | |
| | R/W and RS Hold Time | t_H | 10 | - | - | |
| | Data Output Delay Time | t_D | - | - | 120 | |
| | Data Hold Time | t_{DH} | 5 | - | - | |

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 | | | | - | 夕 | ミ | α | ρ |
| xxxx0001 | (2) | | ! | 1 | A | Q | a | q | | | 。 | ア | チ | △ | ä | q |
| xxxx0010 | (3) | | " | 2 | B | R | b | r | | | 「 | イ | ツ | × | ρ | θ |
| xxxx0011 | (4) | | # | 3 | C | S | c | s | | | 」 | ウ | テ | モ | ε | ε |
| xxxx0100 | (5) | | \$ | 4 | D | T | d | t | | | 、 | エ | ト | ト | μ | Ω |
| xxxx0101 | (6) | | % | 5 | E | U | e | u | | | ・ | オ | ナ | 1 | ε | Ω |
| xxxx0110 | (7) | | & | 6 | F | V | f | v | | | ヲ | カ | ニ | ヨ | ρ | Σ |
| xxxx0111 | (8) | | ' | 7 | G | W | g | w | | | ヲ | キ | ヌ | ラ | g | π |
| xxxx1000 | (1) | | < | 8 | H | X | h | x | | | イ | ク | ネ | リ | γ | Σ |
| xxxx1001 | (2) | | > | 9 | I | Y | i | y | | | ウ | ケ | ル | ル | γ | γ |
| xxxx1010 | (3) | | * | : | J | Z | j | z | | | エ | コ | ハ | 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 | ス | ハ | ン | も | ÷ |
| xxxx1110 | (7) | | . | > | N | ^ | n | → | | | ヨ | セ | ホ | ° | ら | |
| xxxx1111 | (8) | | / | ? | O | _ | o | ← | | | ッ | ソ | 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 10 cycles | |
| Vibration test | Endurance test applying vibration to simulate transportation and use. | 10-55Hz , 15mm amplitude. 60 sec in each of 3 directions X,Y,Z For 15 minutes | 3 |
| Static electricity test | Endurance test applying electric static discharge. | VS=800V, RS=1.5kΩ, CS=100pF 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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- Техническая поддержка проекта;
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