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NHD-C0216CZ-FSW-FBW-3V3

COG (Chip-on-Glass) Liquid Crystal Display Module

NHD- Newhaven Display
C0216- COG, 2 lines x 16 characters
CZ- Model
F- Transflective
SW- Side White LED Backlight
F- FSTN (+)
B- 6:00 View Angle
W- Wide Temp (-20 c ~ +70 c)
3V3- 3Vdd, 3V Backlight
RoHS Compliant

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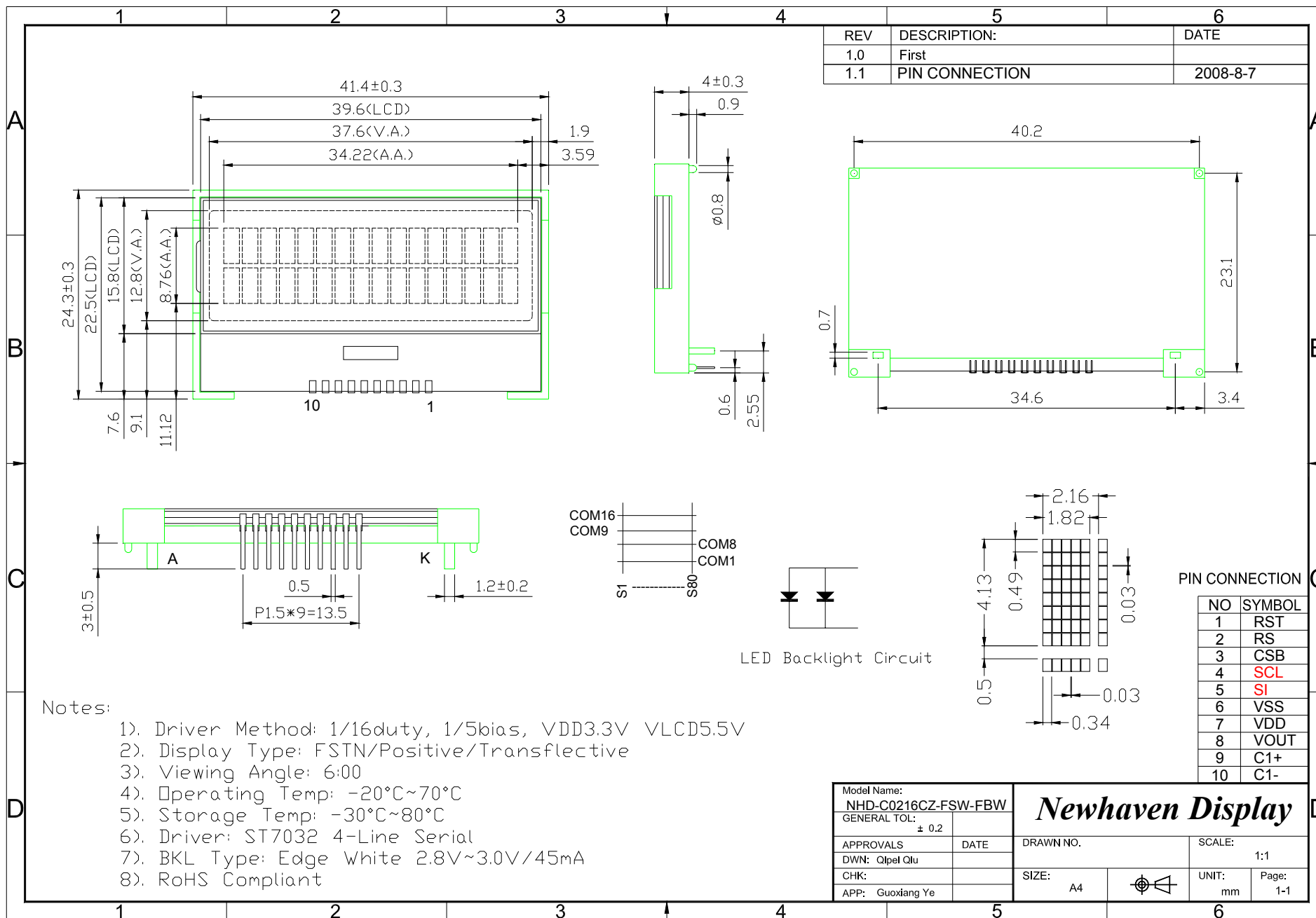
Document Revision History

| Revision | Date | Description | Changed by |
|----------|------------|------------------------------------|------------|
| 0 | 11/11/2008 | Initial Release | |
| 1 | 8/26/2009 | User guide reformat | BE |
| 2 | 10/9/2009 | Updated Electrical Characteristics | MC |
| 3 | 10/22/2009 | Font Table Revision | BE |
| 4 | 10/27/2009 | Updated the Block Diagram | MC |
| 5 | 11/19/2009 | Updated backlight supply current | MC |
| 6 | 12/18/2009 | Pin description updated | BE |
| 7 | 3/2/2012 | Interface information updated | AK |

Functions and Features

- 2 lines x 16 characters
- Built-in controller (ST7032 or equivalent)
- 5x8 dots with cursor
- 4-line serial interface
- 1/16 duty, 1/5 bias

Mechanical Drawing



| REV | DESCRIPTION: | DATE |
|-----|----------------|----------|
| 1.0 | First | |
| 1.1 | PIN CONNECTION | 2008-8-7 |

PIN CONNECTION

| NO | SYMBOL |
|----|--------|
| 1 | RST |
| 2 | RS |
| 3 | CSB |
| 4 | SCL |
| 5 | SI |
| 6 | VSS |
| 7 | VDD |
| 8 | VOUT |
| 9 | C1+ |
| 10 | C1- |

Notes:

- 1). Driver Method: 1/16duty, 1/5bias, VDD3.3V VLCD5.5V
- 2). Display Type: FSTN/Positive/Transflective
- 3). Viewing Angle: 6:00
- 4). Operating Temp: $-20^{\circ}\text{C} \sim 70^{\circ}\text{C}$
- 5). Storage Temp: $-30^{\circ}\text{C} \sim 80^{\circ}\text{C}$
- 6). Driver: ST7032 4-Line Serial
- 7). BKL Type: Edge White 2.8V~3.0V/45mA
- 8). RoHS Compliant

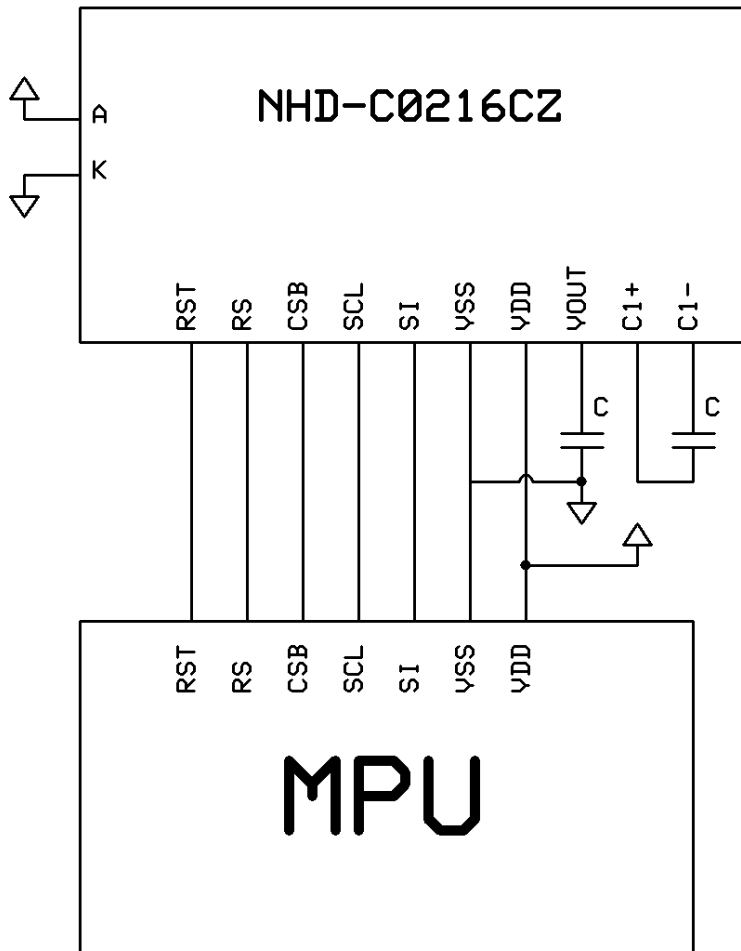
| | | | |
|------------------------------------|------|-------------------------|---------------|
| Model Name: NHD-C0216CZ-FSW-FBW | | Newhaven Display | |
| GENERAL TOL: ± 0.2 | DATE | | |
| APPROVALS | DATE | DRAWN NO. | SCALE: 1:1 |
| DWN: Qlpet Qlu | | SIZE: A4 | UNIT: mm |
| CHK: | | | Page: 1-1 |
| APP: Guoxiang Ye | | | |

Pin Description and Wiring Diagram

| Pin No. | Symbol | External Connection | Function Description |
|---------|--------|---------------------|---|
| 1 | RST | MPU | Active LOW Reset Signal |
| 2 | RS | MPU | Register Select Signal. RS=0: instruction; RS=1: data |
| 3 | CSB | MPU | Active LOW Chip Select signal |
| 4 | SCL | MPU | Serial clock |
| 5 | SI | MPU | Input data |
| 6 | Vss | Power Supply | Ground |
| 7 | VDD | | Power supply for logic for LCD (3.3V). |
| 8 | VOUT | | DC/DC voltage converter. Connect to 1uF capacitor to VDD or Vss |
| 9 | C1+ | | Voltage booster circuit. Connect to 0.47uF-2.2uF cap to PIN10. |
| 10 | C1- | | Voltage booster circuit. Connect to 0.47uF-2.2uF cap to PIN9. |
| A | LED+ | Power Supply | Power supply for Backlight (3.0V) |
| K | LED- | Power Supply | Backlight Ground |

Recommended LCD connector: 1.5mm pitch, 10 pins Soldered to PCB

Backlight connector: A and K pins **Mates with:** - Solder to wires or PCB



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 | | 2.7 | 3.3 | 4.5 | V |
| Supply Current | IDD | VDD= 3.3V | - | 0.3 | 0.5 | mA |
| Supply for LCD (contrast) | VDD-Vo | 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 | - | 30 | 45 | mA |

Optical Characteristics

| Item | Symbol | Condition | Min. | Typ. | Max. | Unit |
|----------------------------|--------|-----------|------|------|------|------|
| Viewing Angle - Vertical | AV | Cr ≥ 2 | -60 | - | +35 | ° |
| Viewing Angle - Horizontal | AH | Cr ≥ 2 | -40 | - | +40 | ° |
| Contrast Ratio | Cr | | - | 6 | - | - |
| Response Time (rise) | Tr | - | - | 150 | 250 | ms |
| Response Time (fall) | Tf | - | - | 150 | 250 | ms |

Controller Information

Built-in ST7032. Download specification at http://www.newhavendisplay.com/app_notes/ST7032.pdf

Table of Commands

| Instruction | Instruction Code | | | | | | | | | | Description | Instruction Execution Time | | |
|----------------------------|------------------|-----|-----|-----|-----|-----|-----|-----|-----|-----|--|----------------------------|------------|------------|
| | RS | R/W | DB7 | DB6 | DB5 | DB4 | DB3 | DB2 | DB1 | DB0 | | OSC=380KHz | OSC=540kHz | OSC=700KHz |
| Clear Display | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | Write "20H" to DDRAM. and set DDRAM address to "00H" from AC | 1.08 ms | 0.76 ms | 0.59 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. | 1.08 ms | 0.76 ms | 0.59 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. | 26.3 us | 18.5 us | 14.3 us |
| Display ON/OFF | 0 | 0 | 0 | 0 | 0 | 0 | 1 | D | C | B | D=1:entire display on C=1:cursor on B=1:cursor position on | 26.3 us | 18.5 us | 14.3 us |
| Function Set | 0 | 0 | 0 | 0 | 1 | DL | N | DH | *0 | IS | DL: interface data is 8/4 bits N: number of line is 2/1 DH: double height font IS: instruction table select | 26.3 us | 18.5 us | 14.3 us |
| Set DDRAM address | 0 | 0 | 1 | AC6 | AC5 | AC4 | AC3 | AC2 | AC1 | AC0 | Set DDRAM address in address counter | 26.3 us | 18.5 us | 14.3 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 | 0 | 0 |
| Write data to RAM | 1 | 0 | D7 | D6 | D5 | D4 | D3 | D2 | D1 | D0 | Write data into internal RAM (DDRAM/CGRAM/ICONRAM) | 26.3 us | 18.5 us | 14.3 us |
| Read data from RAM | 1 | 1 | D7 | D6 | D5 | D4 | D3 | D2 | D1 | D0 | Read data from internal RAM (DDRAM/CGRAM/ICONRAM) | 26.3 us | 18.5 us | 14.3 us |

Note * : this bit is for test command , and must always set to "0"

| Instruction table 0 (IS=0) | | | | | | | | | | | | | | |
|----------------------------|---|---|---|---|-----|-----|-----|-----|-----|-----|--|---------|---------|---------|
| Cursor or Display Shift | 0 | 0 | 0 | 0 | 0 | 1 | S/C | R/L | x | x | S/C and R/L: Set cursor moving and display shift control bit, and the direction, without changing DDRAM data. | 26.3 us | 18.5 us | 14.3 us |
| Set CGRAM | 0 | 0 | 0 | 1 | AC5 | AC4 | AC3 | AC2 | AC1 | AC0 | Set CGRAM address in address counter | 26.3 us | 18.5 us | 14.3 us |

| Instruction table 1 (IS=1) | | | | | | | | | | | | | | |
|---------------------------------|---|---|---|---|---|---|-----|------|------|------|---|---------|---------|---------|
| Internal OSC frequency | 0 | 0 | 0 | 0 | 0 | 1 | BS | F2 | F1 | F0 | BS=1:1/4 bias BS=0:1/5 bias F2~0: adjust internal OSC frequency for FR frequency. | 26.3 us | 18.5 us | 14.3 us |
| Set ICON address | 0 | 0 | 0 | 1 | 0 | 0 | AC3 | AC2 | AC1 | AC0 | Set ICON address in address counter. | 26.3 us | 18.5 us | 14.3 us |
| Power/ICON control/Contrast set | 0 | 0 | 0 | 1 | 0 | 1 | Ion | Bon | C5 | C4 | Ion: ICON display on/off Bon: set booster circuit on/off C5, C4: Contrast set for internal follower mode. | 26.3 us | 18.5 us | 14.3 us |
| Follower control | 0 | 0 | 0 | 1 | 1 | 0 | Fon | Rab2 | Rab1 | Rab0 | Fon: set follower circuit on/off Rab2~0: select follower amplified ratio. | 26.3 us | 18.5 us | 14.3 us |
| Contrast set | 0 | 0 | 0 | 1 | 1 | 1 | C3 | C2 | C1 | C0 | Contrast set for internal follower mode. | 26.3 us | 18.5 us | 14.3 us |

| Display Position | | | | | | | | | | |
|-----------------------------|----|----|----|----|----|----|-------|----|----|----|
| | 1 | 2 | 3 | 4 | 5 | 6 | | 38 | 39 | 40 |
| DDRAM Address (hexadecimal) | 00 | 01 | 02 | 03 | 04 | 05 | | 25 | 26 | 27 |
| | 40 | 41 | 42 | 43 | 44 | 45 | | 65 | 66 | 67 |

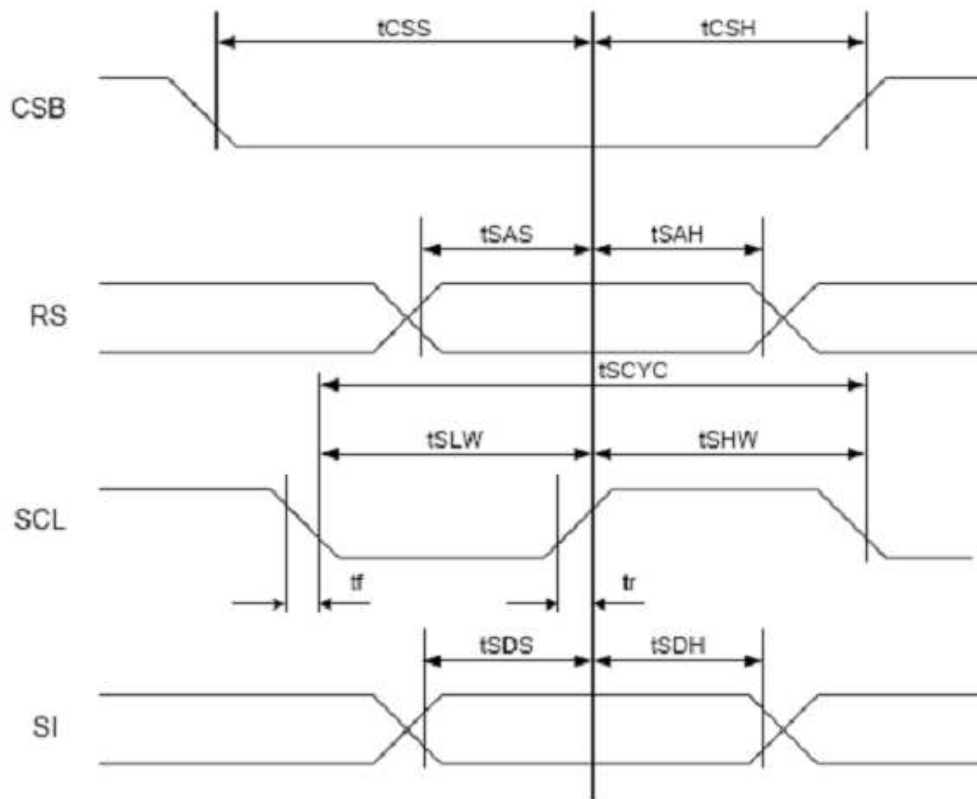
Figure 10. 2-Line Display

Timing Characteristics

($T_a=25^{\circ}\text{C}$, $V_{DD}=3.0\text{V}$)

| Item | Symbol | Symbol | Min. | Typ. | Max. | Unit |
|---------------------|--------|------------|------|------|------|------|
| Serial clock period | SCL | t_{SCYC} | 200 | - | - | ns |
| SCL 'H' pulse width | | t_{SHW} | 20 | - | - | |
| SCL 'L' pulse width | | t_{SLW} | 160 | - | - | |
| SCL rise/fall time | SCL | T_r, t_f | - | - | 20 | |
| Address setup time | RS | t_{SAS} | 10 | - | - | |
| Address hold time | | t_{SAH} | 250 | - | - | |
| Data setup time | SI | t_{SDS} | 10 | - | - | |
| Data hold time | | t_{SDH} | 10 | - | - | |
| CS-SCL time | CS | t_{CSS} | 20 | - | - | |
| | | t_{CSH} | 350 | - | - | |

Serial interface



Built-in Font Table

ST7032-0D (ITO option OPR1=0, OPR2=0)

| b7-b4 b3-b0 | 0000 | 0001 | 0010 | 0011 | 0100 | 0101 | 0110 | 0111 | 1000 | 1001 | 1010 | 1011 | 1100 | 1101 | 1110 | 1111 |
|----------------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|
| 0000 | 0 | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | : | ; | = | > | ? | ~ |
| 0001 | ! | @ | A | B | C | D | E | F | G | H | I | J | K | L | M | N |
| 0010 | O | P | Q | R | S | T | U | V | W | X | Y | Z | [|] | ^ | _ |
| 0011 | 0 | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | : | ; | = | > | ? | ~ |
| 0100 | ! | @ | A | B | C | D | E | F | G | H | I | J | K | L | M | N |
| 0101 | O | P | Q | R | S | T | U | V | W | X | Y | Z | [|] | ^ | _ |
| 0110 | 0 | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | : | ; | = | > | ? | ~ |
| 0111 | ! | @ | A | B | C | D | E | F | G | H | I | J | K | L | M | N |
| 1000 | O | P | Q | R | S | T | U | V | W | X | Y | Z | [|] | ^ | _ |
| 1001 | 0 | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | : | ; | = | > | ? | ~ |
| 1010 | ! | @ | A | B | C | D | E | F | G | H | I | J | K | L | M | N |
| 1011 | O | P | Q | R | S | T | U | V | W | X | Y | Z | [|] | ^ | _ |
| 1100 | 0 | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | : | ; | = | > | ? | ~ |
| 1101 | ! | @ | A | B | C | D | E | F | G | H | I | J | K | L | M | N |
| 1110 | O | P | Q | R | S | T | U | V | W | X | Y | Z | [|] | ^ | _ |
| 1111 | 0 | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | : | ; | = | > | ? | ~ |

Example Initialization Program

```
void init()
//initialize the LCD
{
    P3 = 1;
    P1 = 1;
    RST = 0;                //RESET
    delay(2);
    RST = 1;                //end reset
    delay(20);
    Writecom(0x30);         //wake up
    delay(2);
    Call writecom(0x30);    //wake up
    Call writecom(0x30);    //wake up
    Call writecom(0x39);    //function set
    Call writecom(0x14);    //internal osc frequency
    Call writecom(0x56);    //power control
    Call writecom(0x6D);    //follower control

    Call writecom(0x70);    //contrast
    Call writecom(0x0C);    //display on
    Call writecom(0x06);    //entry mode
    Call writecom(0x01);    //clear
    delay(10);
}

void writecom(int d)
{
    CS = 0;                //CS
    RS = 0;                //A0 = Command
    for(serialcounter = 1; serialcounter <= 8; serialcounter++) //send 8 bits
    {
        if((d&0x80)==0x80) //get only the MSB
            SI=1;         //if 1, then SI=1
        else
            SI=0;         //if 0, then SI=0
        d=(d<<1);        //shift data byte left
        SCL = 0;
        SCL = 1;
        SCL = 0;         //SCL
    }
    CS = 1;
}

void writedata(int d)
{
    CS = 0;                //CS
    RS = 1;                //A0 = Data
    for(serialcounter = 1; serialcounter <= 8; serialcounter++) //send 8 bits
    {
        if((d&0x80)==0x80) //get only the MSB
            SI=1;         //if 1, then SI=1
        else
            SI=0;         //if 0, then SI=0
        d=(d<<1);        //shift data byte left
        SCL = 0;
        SCL = 1;
        SCL = 0;         //SCL
    }
    CS = 1;
}
```

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 , 96hrs | 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