

NHD-C0220BiZ-FSW-FBW-3V3M

COG (Chip-On-Glass) Character Liquid Crystal Display Module

| | |
|--------|-----------------------------------|
| NHD- | Newhaven Display |
| C0220- | COG, 2 Lines x 20 Characters |
| BiZ- | Model, I ² C interface |
| F- | Transflective |
| SW- | Side White LED Backlight |
| F- | FSTN (+) |
| B- | 6:00 Optimal View |
| W- | Wide Temperature |
| 3V3- | 3.3V LCD |
| M- | Mounting Holes |
| | RoHS Compliant |

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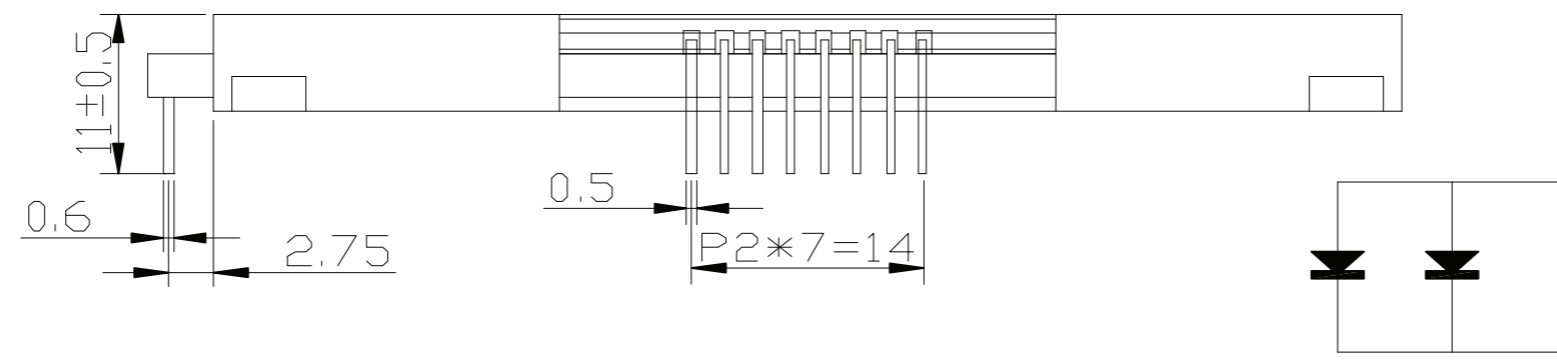
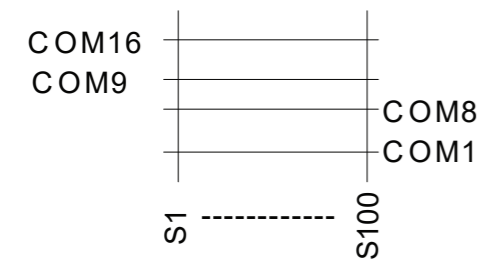
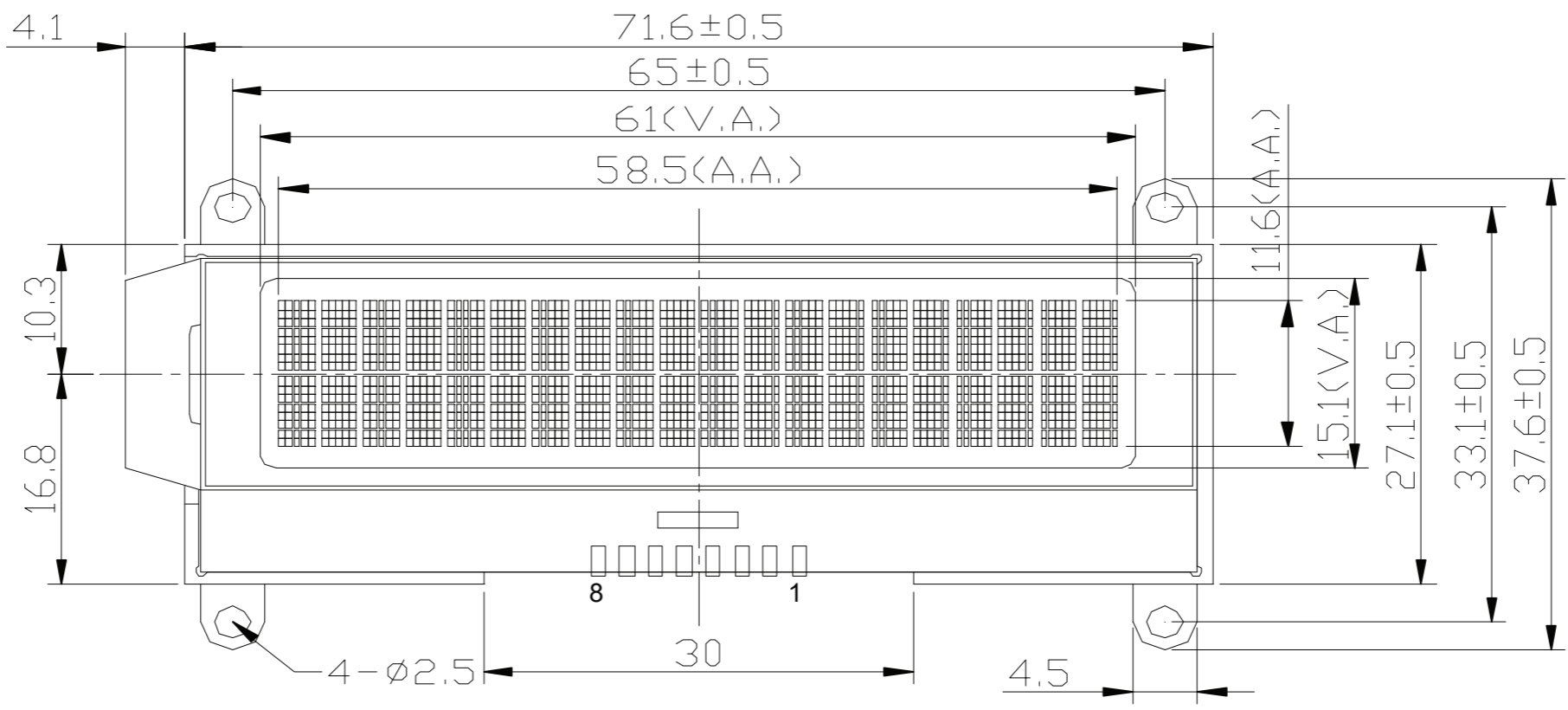
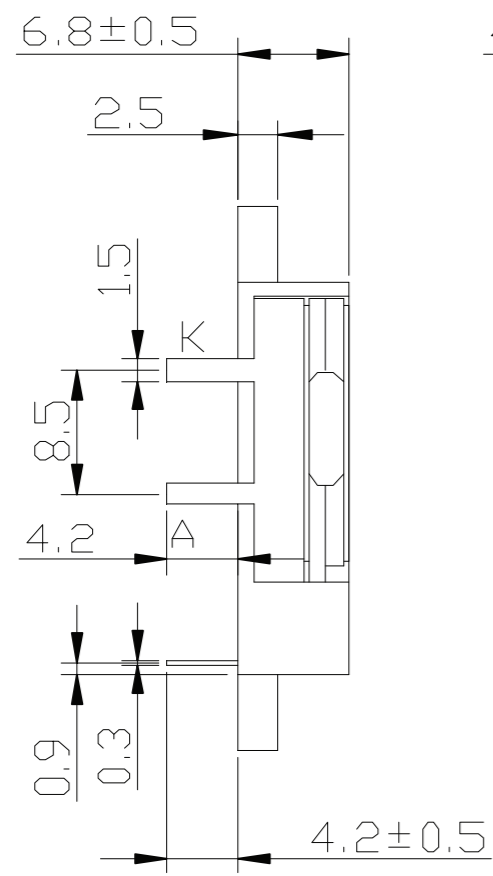
Document Revision History

| Revision | Date | Description | Changed by |
|----------|----------|--|------------|
| 0 | 7/8/09 | Initial Release | |
| 1 | 10/9/09 | Updated Electrical Characteristic | MC |
| 2 | 11/20/09 | Updated backlight supply current | MC |
| 3 | 5/27/11 | Display character address code updated | AK |
| 4 | 6/23/14 | Mechanical Drawing, Electrical & Optical characteristics updated | ML |
| 5 | 3/18/19 | Mechanical Drawing & Electrical Characteristics Updated | SB |
| 6 | 6/24/19 | Added PCB Footprint Drawing | AS |
| 7 | 9/22/20 | Updated Drive Conditions in Electrical Characteristics Table | AS |
| 8 | 10/23/20 | Updated Symbol for LCD Supply Voltage | AS |

Functions and Features

- 2 lines x 20 characters
- Built-in ST7036i controller with I²C interface
- 3.3V power supply
- 1/16 duty, 1/5 bias
- Built-in DC supply for VLCD (requires 2 external capacitors)

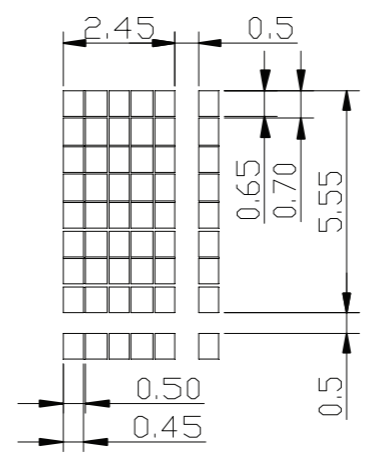
| SYMBOL | REVISION | DATE |
|--------|----------|------|
| | | |



LED Backlight Circuit

| NO | SYMBOL |
|----|--------|
| 1 | RST |
| 2 | SCL |
| 3 | SDA |
| 4 | VSS |
| 5 | VDD |
| 6 | VOUT |
| 7 | C1+ |
| 8 | C1- |

- Notes:**
1. Driver: 1/16 Duty, 1/5 Bias
 2. Voltage: 3.3V VDD, 5.5V VLCD
 3. Display Mode: FSTN Positive / Transflective
 4. Optimal View: 6:00
 5. Backlight: LED
 6. Driver IC: ST7036i I2C Interface



STANDARD TOLERANCE: (UNLESS OTHERWISE SPECIFIED)

LINEAR: ±0.3mm

UNLESS OTHERWISE SPECIFIED:
- DIMENSIONS ARE IN MILLIMETERS
- THIRD ANGLE PROJECTION

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NEWHAVEN DISPLAY INTERNATIONAL

DRAWING/PART NUMBER: NHD-C0220BIZ-FSW-FBW-3V3M

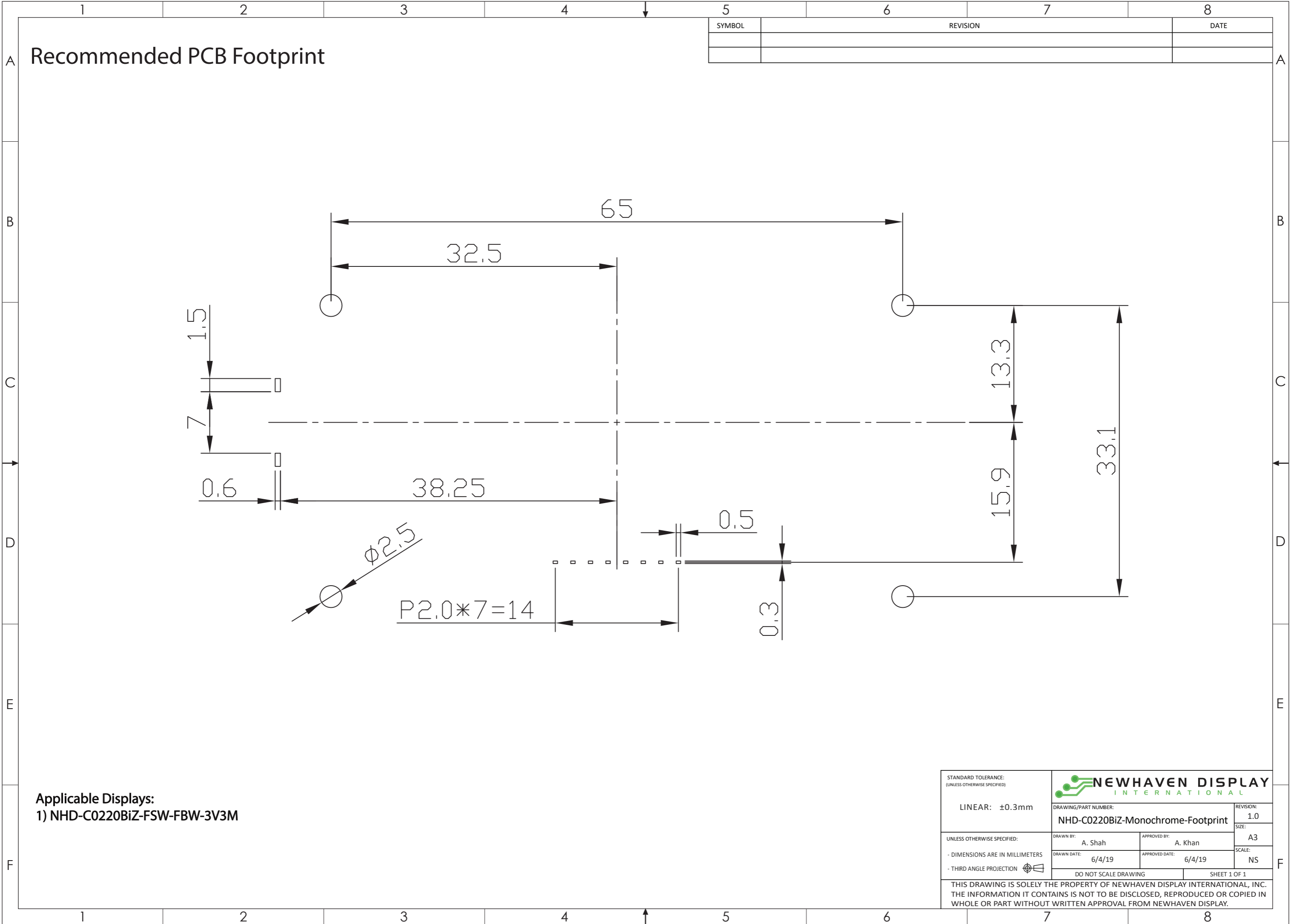
REVISION: 1.0

SIZE: A3

SCALE: NS

SHEET 1 OF 1

DRAWN BY: S. Baxi
APPROVED BY: S. Baxi
DRAWN DATE: 03/18/19
APPROVED DATE: 03/18/19



| SYMBOL | REVISION | DATE |
|--------|----------|------|
| | | |
| | | |

Recommended PCB Footprint

Applicable Displays:
 1) NHD-C0220BiZ-FSW-FBW-3V3M

| | | | |
|---|--|---|--------------------------|
| STANDARD TOLERANCE: (UNLESS OTHERWISE SPECIFIED) | | | |
| LINEAR: ±0.3mm | | DRAWING/PART NUMBER: NHD-C0220BiZ-Monochrome-Footprint | |
| UNLESS OTHERWISE SPECIFIED: - DIMENSIONS ARE IN MILLIMETERS - THIRD ANGLE PROJECTION | | DRAWN BY: A. Shah | APPROVED BY: A. Khan |
| | | DRAWN DATE: 6/4/19 | APPROVED DATE: 6/4/19 |
| | | DO NOT SCALE DRAWING | |
| | | SHEET 1 OF 1 | |
| REVISION: 1.0 SIZE: A3 SCALE: NS | | | |
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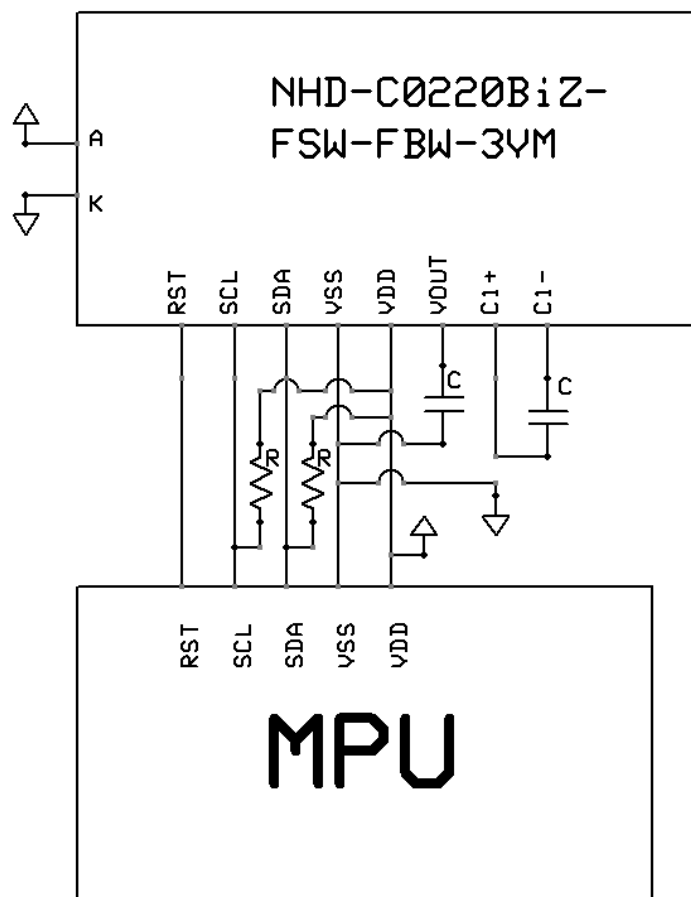
Pin Description and Wiring Diagram

| Pin No. | Symbol | External Connection | Function Description |
|---------|------------------|---------------------|--|
| 1 | RST | MPU | Active LOW Reset signal |
| 2 | SCL | MPU | Serial Clock signal (requires pull-up resistor) |
| 3 | SDA | MPU | Serial Data signal (requires pull-up resistor) |
| 4 | V _{SS} | Power Supply | Ground |
| 5 | V _{DD} | Power Supply | Supply Voltage for logic (+3.3V) |
| 6 | V _{OUT} | CAP | Voltage booster circuit – Connect 0.47μF~2.2μF cap to V _{SS} or V _{DD} |
| 7 | C1+ | CAP | Connect 1μF cap to PIN8 |
| 8 | C1- | CAP | Connect 1μF cap to PIN7 |

Recommended LCD connector: N/A, solder directly into PCB

Backlight connector: 8.5mm pitch pins, solder directly into PCB **Mates with:** ---

Recommended Breakout Board: [NHD-PCB40](#)



Capacitance 0.47μF~2.2μF

Recommended value = 1μF

Recommended Resistor: 10KΩ

Electrical Characteristics

| Item | Symbol | Condition | Min. | Typ. | Max. | Unit |
|-----------------------------------|------------------|--|-----------------------|------|-----------------------|------|
| Operating Temperature Range | T _{OP} | Absolute Max | -20 | - | +70 | °C |
| Storage Temperature Range | T _{ST} | Absolute Max | -30 | - | +80 | °C |
| Supply Voltage | V _{DD} | - | 3.0 | 3.3 | 3.6 | V |
| Supply Current | I _{DD} | V _{DD} = 3.3V | 0.2 | 0.5 | 1.5 | mA |
| Supply for LCD (contrast) | V _{LCD} | V ₀ -V _{SS} , T _{OP} = 25°C | 5.3 | 5.5 | 5.7 | V |
| "H" Level input | V _{IH} | - | 0.7 * V _{DD} | - | V _{DD} | V |
| "L" Level input | V _{IL} | - | V _{SS} | - | 0.2 * V _{DD} | V |
| "H" Level output | V _{OH} | - | 0.7 * V _{DD} | - | V _{DD} | V |
| "L" Level output | V _{OL} | - | V _{SS} | - | 0.8 | V |
| Backlight Supply Current – White | I _{LED} | - | - | 30 | 35 | mA |
| Backlight Supply Voltage – White* | V _{LED} | I _{LED} = 30 mA | 2.8 | 3.0 | 3.3 | V |

*The LED of the backlight is driven by current drain; drive voltage is for reference only. Drive voltage must be selected to ensure backlight current drain is below MAX level stated.

Optical Characteristics

| Item | Symbol | Condition | Min. | Typ. | Max. | Unit |
|------------------------|--------|------------------------|------|------|------|------|
| Optimal Viewing Angles | Top | CR ≥ 2 | - | 40 | - | ° |
| | Bottom | | - | 60 | - | ° |
| | Left | | - | 60 | - | ° |
| | Right | | - | 60 | - | ° |
| Contrast Ratio | CR | - | 2 | 5 | - | - |
| Response Time | Rise | T _{OP} = 25°C | - | 150 | 250 | ms |
| | Fall | | - | 200 | 300 | ms |

Controller Information

Built-in ST7036i controller.

Please download specification at http://www.newhavendisplay.com/app_notes/ST7036.pdf

DDRAM Address

| | | | | | | | | | | | | | | | | | | | |
|----------|----------|----------|----------|----------|----------|----------|----------|----------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|
| 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 | 10 | 11 | 12 | 13 |
| 40 | 41 | 42 | 43 | 44 | 45 | 46 | 47 | 48 | 49 | 4A | 4B | 4C | 4D | 4E | 4F | 50 | 51 | 52 | 53 |

Slave Address = 0x78

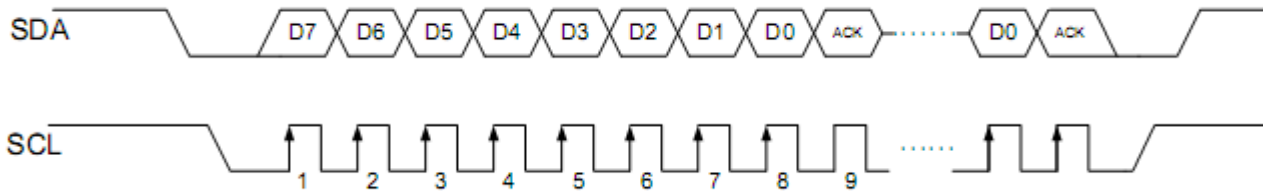
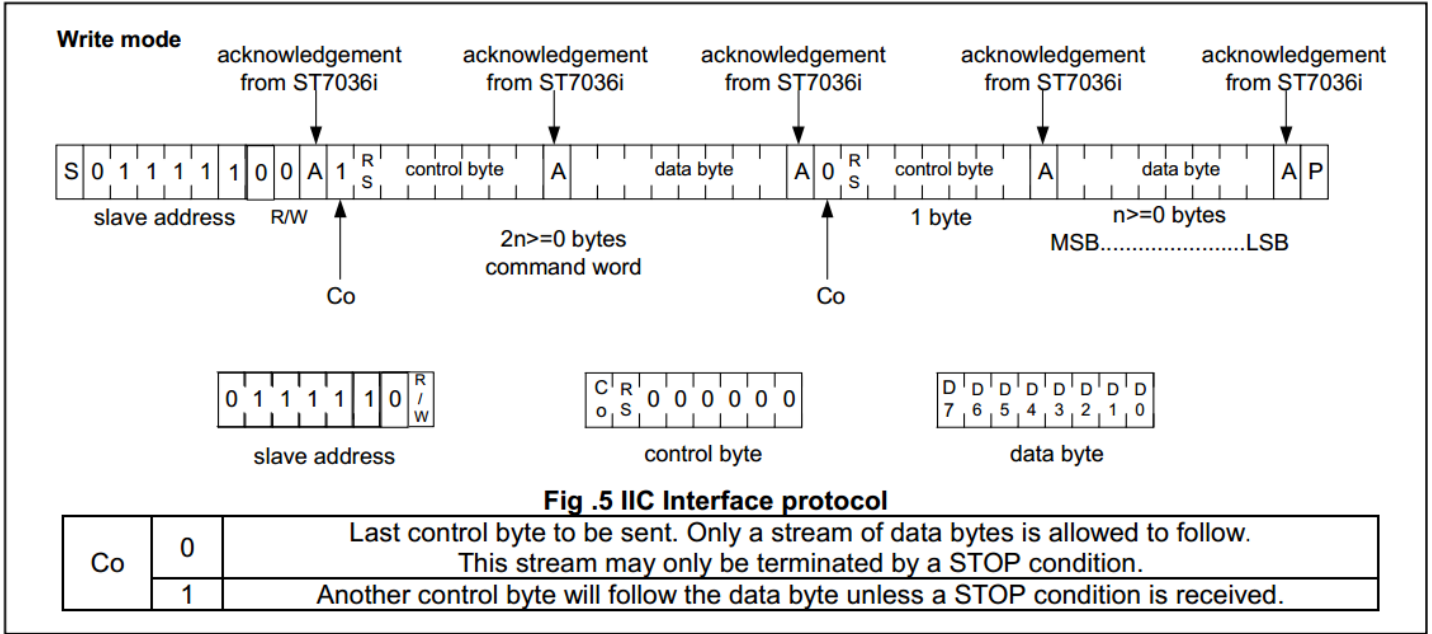


Table of Commands

| Instruction | Instruction Code | | | | | | | | | | Description | |
|----------------------------|------------------|-----|-----|-----|-----|-----|-----|-----|-----|-----|-------------|--|
| | RS | R/W | DB7 | DB6 | DB5 | DB4 | DB3 | DB2 | DB1 | DB0 | | |
| Clear Display | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | Write "20H" to DDRAM. and set DDRAM address to "00H" from AC |
| Return Home | 0 | 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. |
| Entry Mode Set | 0 | 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. |
| Display ON/OFF | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | D | C | B | D=1:entire display on C=1:cursor on B=1:cursor position on |
| Function Set | 0 | 0 | 0 | 0 | 1 | DL | N | DH | IS2 | IS1 | | DL: interface data is 8/4 bits N: number of line is 2/1 DH: double height font IS[2:1]: instruction table select |
| Set DDRAM Address | 0 | 0 | 1 | AC6 | AC5 | AC4 | AC3 | AC2 | AC1 | AC0 | | Set DDRAM address in address counter |
| 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. |
| Write Data to RAM | 1 | 0 | D7 | D6 | D5 | D4 | D3 | D2 | D1 | D0 | | Write data into internal RAM (DDRAM/CGRAM/ICONRAM) |
| Read Data from RAM | 1 | 1 | D7 | D6 | D5 | D4 | D3 | D2 | D1 | D0 | | Read data from internal RAM (DDRAM/CGRAM/ICONRAM) |

Instruction table 0(IS[2:1]=[0,0])

| | | | | | | | | | | | |
|-------------------------|---|---|---|---|-----|-----|-----|-----|-----|-----|--|
| 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. |
| Set CGRAM | 0 | 0 | 0 | 1 | AC5 | AC4 | AC3 | AC2 | AC1 | AC0 | Set CGRAM address in address counter |

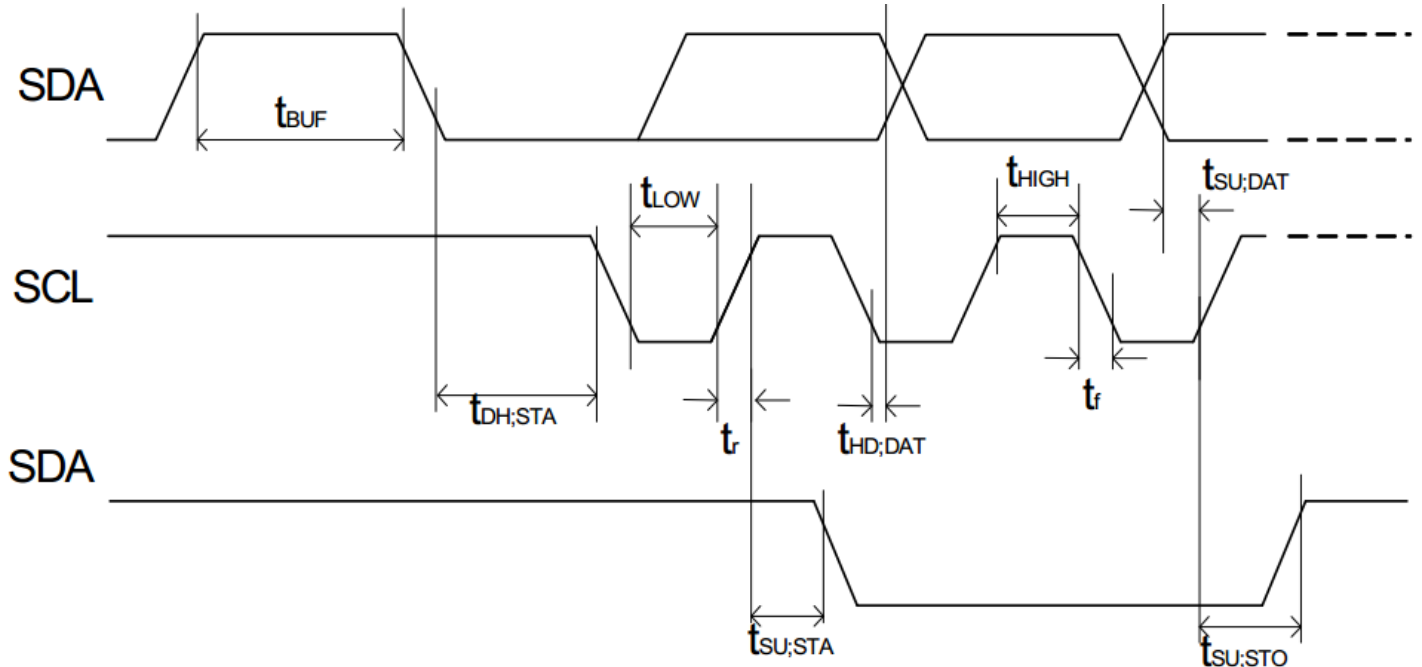
Instruction table 1(IS[2:1]=[0,1])

| | | | | | | | | | | | |
|----------------------------------|---|---|---|---|---|---|-----|------|------|------|---|
| Bias Set | 0 | 0 | 0 | 0 | 0 | 1 | BS | 1 | 0 | FX | BS=1:1/4 bias BS=0:1/5 bias FX: fixed on high in 3-line application and fixed on low in other applications. |
| Set ICON Address | 0 | 0 | 0 | 1 | 0 | 0 | AC3 | AC2 | AC1 | AC0 | Set ICON address in address counter. |
| 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. |
| Follower Control | 0 | 0 | 0 | 1 | 1 | 0 | Fon | Rab2 | Rab1 | Rab0 | Fon: set follower circuit on/off Rab2~0: select follower amplified ratio. |
| Contrast Set | 0 | 0 | 0 | 1 | 1 | 1 | C3 | C2 | C1 | C0 | Contrast set for internal follower mode. |

Instruction table 2(IS[2:1]=[1,0])

| | | | | | | | | | | | |
|-------------------------------|---|---|---|---|---|---|----|---|---|---|-----------------------------------|
| Double Height Position Select | 0 | 0 | 0 | 0 | 0 | 1 | UD | X | x | x | UD: Double height position select |
| Reserved | 0 | 0 | 0 | 1 | X | X | X | X | X | X | Do not use (reserved for test) |

Timing Characteristics



| Item | Signal | Symbol | Condition | VDD=2.7 to 4.5V Rating | | VDD=4.5 to 5.5V Rating | | Units |
|--|-------------|--------------|-----------|------------------------|------|------------------------|------|---------|
| | | | | Min. | Max. | Min. | Max. | |
| SCL clock frequency | SCL | f_{SCLK} | — | DC | 300K | DC | 400 | kHz |
| SCL clock low period | | t_{LOW} | — | 2.5 | — | 1.3 | — | μ s |
| SCL clock high period | | t_{HIGH} | — | 0.6 | — | 0.6 | — | |
| Data set-up time | SDA | $t_{SU,DAT}$ | — | 1800 | — | 700 | — | ns |
| Data hold time | | $t_{HD,DAT}$ | — | 0 | — | 0 | 0.5 | μ s |
| SCL,SDA rise time | SCL, SDA | t_r | — | $20+0.1C_b$ | 300 | $20+0.1C_b$ | 300 | ns |
| SCL,SDA fall time | | t_r | — | $20+0.1C_b$ | 300 | $20+0.1C_b$ | 300 | |
| Capacitive load represent by each bus line | | C_b | — | — | 400 | — | 400 | pf |
| Setup time for a repeated START condition | SDA | $t_{SU,STA}$ | — | 0.6 | — | 0.6 | — | μ s |
| Start condition hold time | | $t_{HD,STA}$ | — | 1.8 | — | 1.0 | — | μ s |
| Setup time for STOP condition | | $t_{SU,STO}$ | — | 0.6 | — | 0.6 | — | μ s |
| Bus free time between a Stop and START condition | SCL | t_{BUF} | — | 1.3 | — | 1.3 | — | μ s |

Built-in Font Table (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 | █ | █ | █ | █ | █ | █ | █ | █ | █ | █ | █ | █ | █ | █ | █ | █ |
| 0001 | █ | █ | █ | █ | █ | █ | █ | █ | █ | █ | █ | █ | █ | █ | █ | █ |
| 0010 | █ | █ | █ | █ | █ | █ | █ | █ | █ | █ | █ | █ | █ | █ | █ | █ |
| 0011 | █ | █ | █ | █ | █ | █ | █ | █ | █ | █ | █ | █ | █ | █ | █ | █ |
| 0100 | █ | █ | █ | █ | █ | █ | █ | █ | █ | █ | █ | █ | █ | █ | █ | █ |
| 0101 | █ | █ | █ | █ | █ | █ | █ | █ | █ | █ | █ | █ | █ | █ | █ | █ |
| 0110 | █ | █ | █ | █ | █ | █ | █ | █ | █ | █ | █ | █ | █ | █ | █ | █ |
| 0111 | █ | █ | █ | █ | █ | █ | █ | █ | █ | █ | █ | █ | █ | █ | █ | █ |
| 1000 | █ | █ | █ | █ | █ | █ | █ | █ | █ | █ | █ | █ | █ | █ | █ | █ |
| 1001 | █ | █ | █ | █ | █ | █ | █ | █ | █ | █ | █ | █ | █ | █ | █ | █ |
| 1010 | █ | █ | █ | █ | █ | █ | █ | █ | █ | █ | █ | █ | █ | █ | █ | █ |
| 1011 | █ | █ | █ | █ | █ | █ | █ | █ | █ | █ | █ | █ | █ | █ | █ | █ |
| 1100 | █ | █ | █ | █ | █ | █ | █ | █ | █ | █ | █ | █ | █ | █ | █ | █ |
| 1101 | █ | █ | █ | █ | █ | █ | █ | █ | █ | █ | █ | █ | █ | █ | █ | █ |
| 1110 | █ | █ | █ | █ | █ | █ | █ | █ | █ | █ | █ | █ | █ | █ | █ | █ |
| 1111 | █ | █ | █ | █ | █ | █ | █ | █ | █ | █ | █ | █ | █ | █ | █ | █ |

Example Initialization Program

```

/*****
*           Initialization For ST7036i           *
*****/
void init_LCD()
{
I2C_Start();
I2C_out(Slave); //Slave=0x78
I2C_out(Comsend); //Comsend = 0x00
I2C_out(0x38);
delay(10);
I2C_out(0x39);
delay(10);
I2C_out(0x14);
I2C_out(0x78);
I2C_out(0x5E);
I2C_out(0x6D);
I2C_out(0x0C);
I2C_out(0x01);
I2C_out(0x06);
delay(10);
I2C_Stop();
}
/*****/

/*****
*           Output command or data via I2C           *
*****/
void I2C_out(unsigned char j)           //I2C Output
{
    int n;
    unsigned char d;
    d=j;
    for(n=0;n<8;n++){
        if((d&0x80)==0x80)
            SDA=1;
        else
            SDA=0;
        d=(d<<1);
        SCL = 0;
        SCL = 1;
        SCL = 0;
    }
    SCL = 1;
    while(SDA==1){
        SCL=0;
        SCL=1;
    }
    SCL=0;
}
/*****/

```

```

/*****
*           I2C Start                               *
*****/
void I2C_Start(void)
{
    SCL=1;
    SDA=1;
    SDA=0;
    SCL=0;
}
/*****/

/*****
*           I2C Stop                               *
*****/
void I2C_Stop(void)
{
    SDA=0;
    SCL=0;
    SCL=1;
    SDA=1;
}
/*****/

/*****
*           Send string of ASCII data to LCD      *
*****/
void Show(unsigned char *text)
{
    int n,d;
    d=0x00;
    I2C_Start();
    I2C_out(Slave); //Slave=0x78
    I2C_out(Datasend); //Datasend=0x40
    for(n=0;n<20;n++){
        I2C_out(*text);
        ++text;
    }
    I2C_Stop();
}
/*****/
/*****/
/*****/

```

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. | +60°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. | -20°C,30min -> 25°C,5min -> 70°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

See Terms & Conditions at http://www.newhavendisplay.com/index.php?main_page=terms