# NHD-320240WG-BxTFH-VZ#

## Graphic Liquid Crystal Display Module

| | |
|---|---|
| NHD- | Newhaven Display |
| 320240- | 320 x 240 pixels |
| WG- | Display Type: Graphic |
| Bx- | Model |
| T- | White LED Backlight |
| F- | FSTN (+) |
| H- | Transflective, 6:00 view, Wide Temperature (-20°C ~+70°C) |
| VZ#- | Built-in Negative Voltage |
| | **RoHS Compliant** |


**Newhaven Display International, Inc.**
**2511 Technology Drive, Suite 101**
**Elgin IL, 60124**
**Ph: 847-844-8795 Fax: 847-844-8796**

www.newhavendisplay.com
nhtech@newhavendisplay.com nhsales@newhavendisplay.com

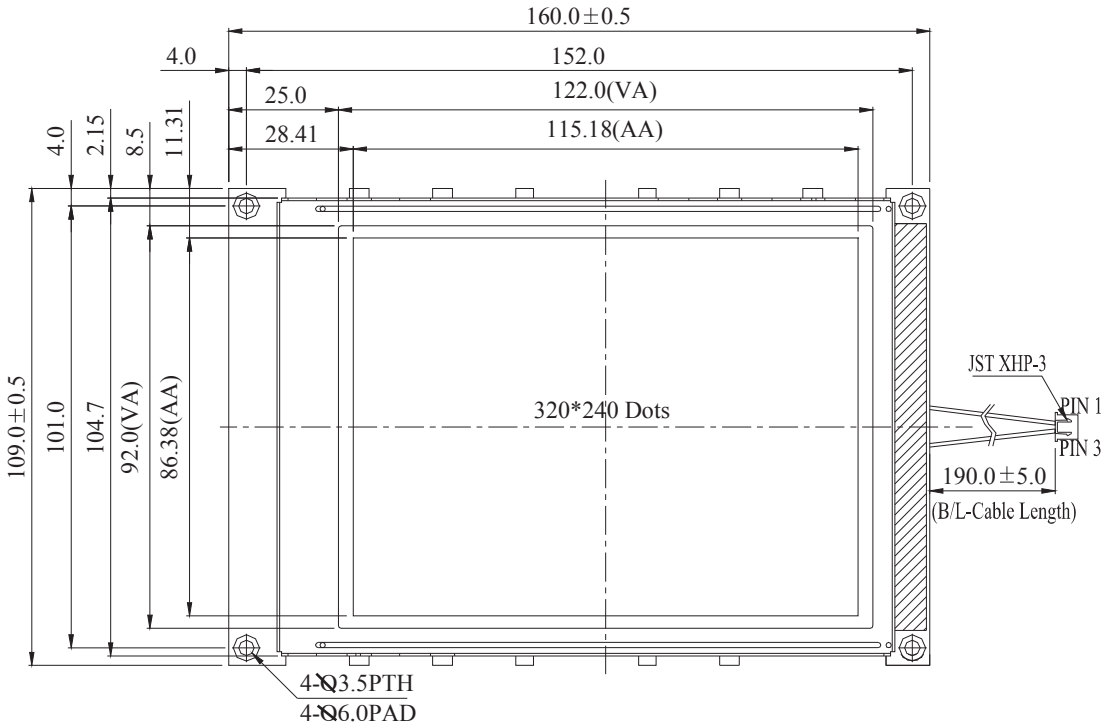
## Document Revision History

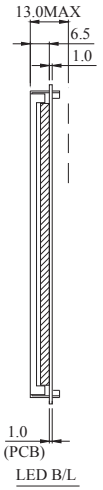
| Revision | Date | Description | Changed by |
|---|---|---|---|
| **0** | **6/7/2007** | **Initial Release** | **-** |
| 1 | **4/20/2010** | **User guide reformat** | **MC** |
| 2 | **9/22/2011** | **Electrical characteristics updated** | **AK** |

## Functions and Features

- **320 x 240 pixels**
- **Built-in S1D13700 Controller**
- **+5.0V or +3.3V power supply**
- **RoHS Compliant**

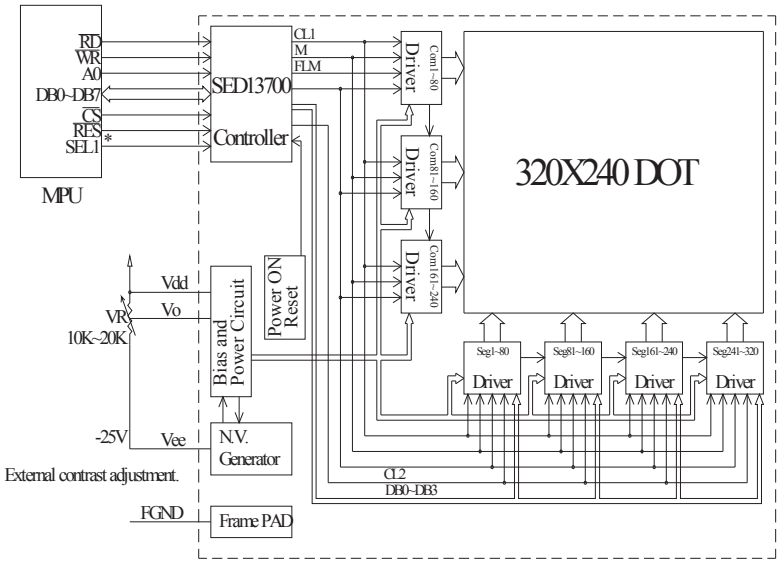
# Mechanical Drawing



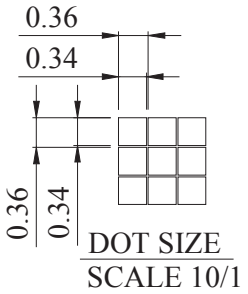




The non-specified tolerance of dimension is ±0.3mm.

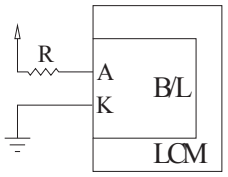
| PIN NO. | SYMBOL |
|---|---|
| 1 | VSS |
| 2 | VDD |
| 3 | Vo |
| 4 | A0 |
| 5 | R/W |
| 6 | E |
| 7 | DB0 |
| 8 | DB1 |
| 9 | DB2 |
| 10 | DB3 |
| 11 | DB4 |
| 12 | DB5 |
| 13 | DB6 |
| 14 | DB7 |
| 15 | /CS |
| 16 | /RST |
| 17 | Vee |
| 18 | NC |
| 19 | FG |
| 20 | NC |




*:6800 family or 8080family interface selectable.




LED B/L drive directly from A and K.



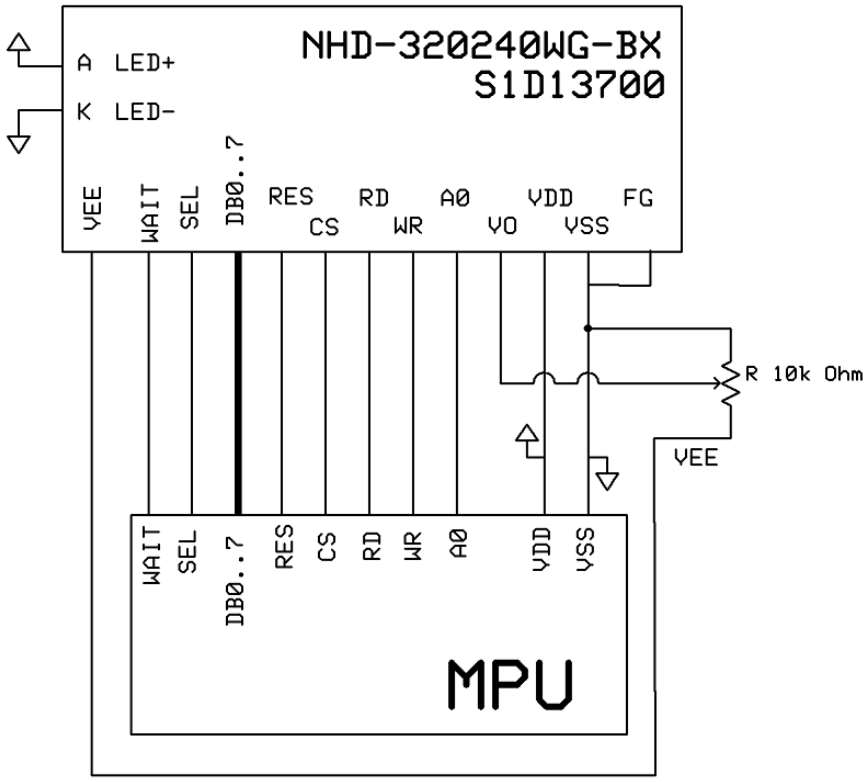

**Newhaven Display**

NHD-320240WG-BxTFH-VZ#

## Pin Description and Wiring Diagram

| Pin No. | Symbol | External Connection | Function Description |
|---|---|---|---|
| 1 | VSS | Power Supply | Ground |
| 2 | VDD | Power Supply | Power supply for logic (+5.0V) |
| 3 | V0 | Adj Power Supply | Power supply for contrast (approx. -18.8V) |
| 4 | A0 | MPU | Register select signal. A0=0: Command, A0=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. |
| 7-14 | DB0-DB7 | MPU | Bi-directional three-state data bus lines. |
| 15 | /CS | MPU | Active LOW chip select |
| 16 | /RST | MPU | Active LOW reset signal |
| 17 | VEE | Power Supply | Negative voltage output (-25V) |
| 18 | NC | - | No Connect |
| 19 | FG | - | No Connect |
| 20 | NC | - | No Connect |

**Recommended LCD connector:** 1.0mm pitch, 20-pos FFC connector
**Backlight connector:** JST p/n: XHP-3 **Mates with**: JST p/n: B 3B-XH-A



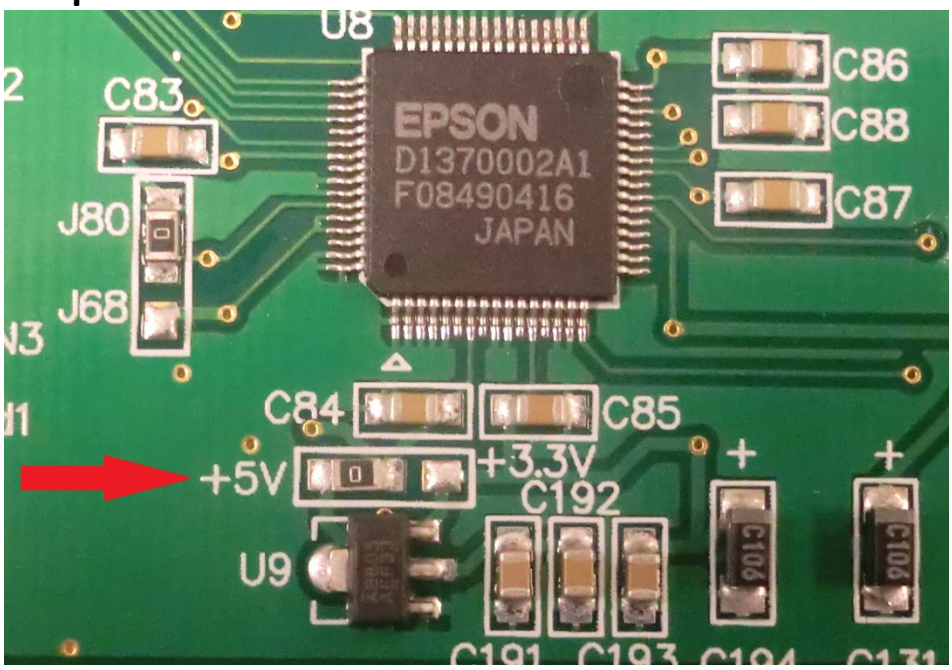
## Electrical Characteristics

| 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 | | 3.3 | 5.0 | 5.25 | V |
| Supply Current | IDD | Ta=25°C, VDD=5.0V | 65.0 | 75.0 | 85.0 | mA |
| Supply for LCD (contrast) | VDD-VLCD | Ta=25°C | 22.0 | 23.8 | 26.1 | V |
| "H" Level input | VIH | | 0.5VDD | - | VDD | V |
| "L" Level input | VIL | - | 0 | - | 0.2VDD | V |
| "H" Level output | VOH | - | -0.4VDD | - | - | 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 | 140 | 160 | 180 | mA |
| Backlight Lifetime | | ILED=160mA | - | 50,000 | - | Hrs |

## Optical Characteristics

| Item | Symbol | Condition | Min. | Typ. | Max. | Unit |
|---|---|---|---|---|---|---|
| Viewing Angle - Vertical | AV | Cr ≥ 2 | -30 | - | 60 | º |
| Viewing Angle - Horizontal | AH | Cr ≥ 2 | -45 | - | 45 | º |
| Contrast Ratio | Cr | | - | 5 | - | - |
| Response Time (rise) | Tr | - | - | 200 | 300 | ms |
| Response Time (fall) | Tf | - | - | 150 | 200 | ms |

## Jumper Selection




## Controller Information

**Built-in S1D13700. Download specification at [http://www.newhavendisplay.com/app_notes/S1D13700.pdf](http://www.newhavendisplay.com/app_notes/S1D13700.pdf)**

# Table of Commands

**REG[01h] Horizontal Character Size Register**
Address = 8001h Default = 00h Read/Write

| 7 | 6 | 5 | 4 | 3 | 2 | 1 | 0 |
|---|---|---|---|---|---|---|---|
| MOD | n/a | | | Horizontal Character Size bits 3-0 | | | |

**REG[02h] Vertical Character Size Register**
Address = 8002h Default = 00h Read/Write

| 7 | 6 | 5 | 4 | 3 | 2 | 1 | 0 |
|---|---|---|---|---|---|---|---|
| n/a | | | | Vertical Character Size bits 3-0 | | | |

**REG[03h] Character Bytes Per Row Register**
Address = 8003h Default = 00h Read/Write

| 7 | 6 | 5 | 4 | 3 | 2 | 1 | 0 |
|---|---|---|---|---|---|---|---|
| Character Bytes Per Row bits 7-0 | | | | | | | |

**REG[04h] Total Character Bytes Per Row Register**
Address = 8004h Default = 00h Read/Write

| 7 | 6 | 5 | 4 | 3 | 2 | 1 | 0 |
|---|---|---|---|---|---|---|---|
| Total Character Bytes Per Row bits 7-0 | | | | | | | |

**REG[05h] Frame Height Register**
Address = 8005h Default = 00h Read/Write

| 7 | 6 | 5 | 4 | 3 | 2 | 1 | 0 |
|---|---|---|---|---|---|---|---|
| Frame Height bits 7-0 | | | | | | | |

**REG[06h] Horizontal Address Range Register 0**
Address = 8006h Default = 00h Read/Write

| 7 | 6 | 5 | 4 | 3 | 2 | 1 | 0 |
|---|---|---|---|---|---|---|---|
| Horizontal Address Range bits 7-0 | | | | | | | |

**REG[07h] Horizontal Address Range Register 1**
Address = 8007h Default = 00h Read/Write

| 7 | 6 | 5 | 4 | 3 | 2 | 1 | 0 |
|---|---|---|---|---|---|---|---|
| Horizontal Address Range bits 15-8 | | | | | | | |

**REG[08h] Power Save Mode Register**
Address = 8008h Default = 01h Read/Write

| 7 | 6 | 5 | 4 | 3 | 2 | 1 | 0 |
|---|---|---|---|---|---|---|---|
| n/a | | | | | | | Power Save Mode Enable |

**REG[09h] Display Enable Register**
Address = 8009h Default = 00h Read/Write

| 7 | 6 | 5 | 4 | 3 | 2 | 1 | 0 |
|---|---|---|---|---|---|---|---|
| n/a | | | | | | | Display Enable |

**REG[0Ah] Display Attribute Register**
Address = 800Ah Default = 00h Read/Write

| 7 | 6 | 5 | 4 | 3 | 2 | 1 | 0 |
|---|---|---|---|---|---|---|---|
| SAD3 Attribute bits 1-0 | | SAD2 Attribute bits 1-0 | | SAD1 Attribute bits 1-0 | | Cursor Attribute bits 1-0 | |

**REG[0Bh] Screen Block 1 Start Address Register 0**
Address = 800Bh Default = 00h Read/Write

| 7 | 6 | 5 | 4 | 3 | 2 | 1 | 0 |
|---|---|---|---|---|---|---|---|
| Screen Block 1 Start Address bits 7-0 (LSB) | | | | | | | |

**REG[0Ch] Screen Block 1 Start Address Register 1**
Address = 800Ch Default = 00h Read/Write

| 7 | 6 | 5 | 4 | 3 | 2 | 1 | 0 |
|---|---|---|---|---|---|---|---|
| Screen Block 1 Start Address bits 15-8 (MSB) | | | | | | | |

**REG[0Dh] Screen Block 1 Size Register**
Address = 800Dh Default = 00h Read/Write

| 7 | 6 | 5 | 4 | 3 | 2 | 1 | 0 |
|---|---|---|---|---|---|---|---|
| Screen Block 1 Size bits 7-0 | | | | | | | |

**REG[0Eh] Screen Block 2 Start Address Register 0**

Address = 800Eh Default = 00h Read/Write

| 7 | 6 | 5 | 4 | 3 | 2 | 1 | 0 |
|---|---|---|---|---|---|---|---|
| Screen Block 2 Start Address bits 7-0 (LSB) | | | | | | | |

**REG[0Fh] Screen Block 2 Start Address Register 1**

Address = 800Fh Default = 00h Read/Write

| 7 | 6 | 5 | 4 | 3 | 2 | 1 | 0 |
|---|---|---|---|---|---|---|---|
| Screen Block 2 Start Address bits 15-8 (MSB) | | | | | | | |

**REG[10h] Screen Block 2 Size Register**

Address = 8010h Default = 00h Read/Write

| 7 | 6 | 5 | 4 | 3 | 2 | 1 | 0 |
|---|---|---|---|---|---|---|---|
| Screen Block 2 Size bits 7-0 | | | | | | | |

**REG[11h] Screen Block 3 Start Address Register 0**

Address = 8011h Default = 00h Read/Write

| 7 | 6 | 5 | 4 | 3 | 2 | 1 | 0 |
|---|---|---|---|---|---|---|---|
| Screen Block 3 Start Address bits 7-0 (LSB) | | | | | | | |

**REG[12h] Screen Block 3 Start Address Register 1**

Address = 8012h Default = 00h Read/Write

| 7 | 6 | 5 | 4 | 3 | 2 | 1 | 0 |
|---|---|---|---|---|---|---|---|
| Screen Block 3 Start Address bits 15-8 (MSB) | | | | | | | |

**REG[13h] Screen Block 4 Start Address Register 0**

Address = 8013h Default = 00h Read/Write

| 7 | 6 | 5 | 4 | 3 | 2 | 1 | 0 |
|---|---|---|---|---|---|---|---|
| Screen Block 4 Start Address bits 7-0 (LSB) | | | | | | | |

**REG[14h] Screen Block 4 Start Address Register 1**

Address = 8014h Default = 00h Read/Write

| 7 | 6 | 5 | 4 | 3 | 2 | 1 | 0 |
|---|---|---|---|---|---|---|---|
| Screen Block 4 Start Address bits 15-8 (MSB) | | | | | | | |

**REG[15h] Cursor Width Register**

Address = 8015h Default = 00h Read/Write

| 7 | 6 | 5 | 4 | 3 | 2 | 1 | 0 |
|---|---|---|---|---|---|---|---|
| n/a | | | | Cursor Width bits 3-0 | | | |

**REG[16h] Cursor Height Register**

Address = 8016h Default = 00h Read/Write

| 7 | 6 | 5 | 4 | 3 | 2 | 1 | 0 |
|---|---|---|---|---|---|---|---|
| Cursor Mode | n/a | | | Cursor Height bits 3-0 | | | |

**REG[17h] Cursor Shift Direction Register**

Address = 8017h Default = 00h Read/Write

| 7 | 6 | 5 | 4 | 3 | 2 | 1 | 0 |
|---|---|---|---|---|---|---|---|
| n/a | | | | | | Cursor Shift Direction bits 1-0 | |

**REG[18h] Overlay Register**

Address = 8018h Default = 00h Read/Write

| 7 | 6 | 5 | 4 | 3 | 2 | 1 | 0 |
|---|---|---|---|---|---|---|---|
| n/a | | | 3 Layer Overlay Select | Screen Block 3 Display Mode | Screen Block 1 Display Mode | Layer Composition Method bits 1-0 | |

**REG[19h] Character Generator RAM Start Address Register 0**

Address = 8019h Default = 00h Read/Write

| 7 | 6 | 5 | 4 | 3 | 2 | 1 | 0 |
|---|---|---|---|---|---|---|---|
| CGRAM Start Address bits 7-0 (LSB) | | | | | | | |

**REG[1Ah] Character Generator RAM Start Address Register 1**

Address = 801Ah Default = 00h Read/Write

| 7 | 6 | 5 | 4 | 3 | 2 | 1 | 0 |
|---|---|---|---|---|---|---|---|
| CGRAM Start Address bits 15-8 (MSB) | | | | | | | |

**REG[1Bh] Horizontal Pixel Scroll Register**

Address = 801Bh Default = 00h Read/Write

| 7 | 6 | 5 | 4 | 3 | 2 | 1 | 0 |
|---|---|---|---|---|---|---|---|
| n/a | | | | | Horizontal Pixel Scroll bits 2-0 | | |

**REG[1Ch] Cursor Write Register 0**

Address = 801Ch  Default = 00h  Write Only

| Cursor Write bits 7-0 (LSB) | | | | | | | |
|---|---|---|---|---|---|---|---|
| 7 | 6 | 5 | 4 | 3 | 2 | 1 | 0 |

**REG[1Dh] Cursor Write Register 1**

Address = 801Dh  Default = 00h  Write Only

| Cursor Write bits 15-8 (MSB) | | | | | | | |
|---|---|---|---|---|---|---|---|
| 7 | 6 | 5 | 4 | 3 | 2 | 1 | 0 |

**REG[1Eh] Cursor Read Register 0**

Address = 801Eh  Default = 00h  Read Only

| Cursor Read bits 7-0 (LSB) | | | | | | | |
|---|---|---|---|---|---|---|---|
| 7 | 6 | 5 | 4 | 3 | 2 | 1 | 0 |

**REG[1Fh] Cursor Read Register 1**

Address = 801Fh  Default = 00h  Read Only

| Cursor Read bits 15-8 (MSB) | | | | | | | |
|---|---|---|---|---|---|---|---|
| 7 | 6 | 5 | 4 | 3 | 2 | 1 | 0 |

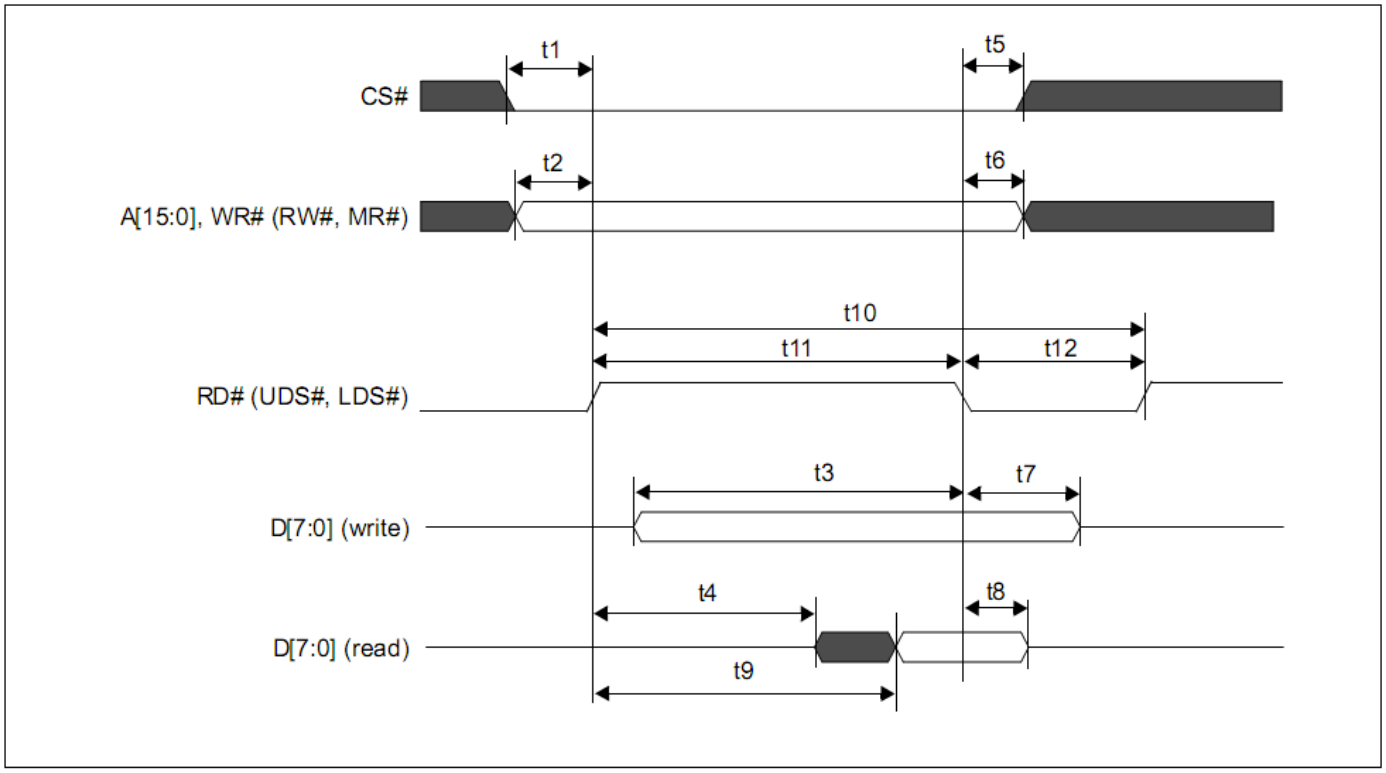
**REG[20h] Bit-Per-Pixel Select Register**

Address = 8020h  Default = 00h  Read/Write

| n/a | | | | | | Bit-Per-Pixel Select bits 1-0 | |
|---|---|---|---|---|---|---|---|
| 7 | 6 | 5 | 4 | 3 | 2 | 1 | 0 |

# Timing Characteristics

## 7.3.5 M6800 Family Bus Indirect Interface Timing




| Symbol | Parameter | 3.3 Volt | | 5.0 Volt | | Units |
|---|---|---|---|---|---|---|
| | | Min | Max | Min | Max | |
| t1 | CS# setup time | 5 | — | 5 | — | ns |
| t2 | A[15:0] setup time | 5 | — | 5 | — | ns |
| t3 | D[7:0] setup time to RD# falling edge (write cycle) | Note 2 | — | Note 2 | — | ns |
| t4 | RD# rising edge to D[7:0] driven (read cycle) | 3 | — | 3 | — | ns |
| t5 | CS# hold time | 7 | — | 7 | — | ns |
| t6 | A[15:0] hold time | 7 | — | 7 | — | ns |
| t7 | D[7:0] hold time from RD# falling edge (write cycle) | 5 | — | 5 | — | ns |
| t8 | D[7:0] hold time from RD# falling edge (read cycle) | 2 | 55 | 2 | 55 | ns |
| t9 | RD# rising edge to valid Data | — | Note 3 | — | Note 3 | ns |
| t10 | RD# cycle time | Note 4 | — | Note 4 | — | ns |
| t11 | RD# pulse active time | 5 | — | 5 | — | Ts |
| t12 | RD# pulse inactive time | Note 5 | — | Note 5 | — | ns |

## Example Initialization Program:

```
//-------------------------------------------------------------------------
Sub Writecom
 Set P3.0                                                    'A0 = H = Write command
 P1 = A                                                      'move data to P1
 Reset P3.1                                                  'chip select
 Reset P3.7                                                  'R/W
 Set P3.4                                                    'E
 Reset P3.4                                                  'E
 Set P3.7                                                    'R/W
 Set P3.1                                                    'CS
End Sub

Sub Writedata
 Reset P3.0                                                  'A0 = L = Write data
 P1 = A
 Reset P3.1
 Reset P3.7
 Set P3.4
 Reset P3.4
 Set P3.7
 Set P3.1
End Sub
//-------------------------------------------------------------------------
Sub Init
 Set P3.2                                                    'SEL=1 = Motorola 6800 write
interface
 Reset P3.6                                                  'RESET
 Waitms 10                                                   'wait
 Set P3.6                                                    'RESET done
 Waitms 100                                                  'wait
 A = &H40                                                    'system set command
 Call Writecom
 A = &H30                                                    'set parameters
 Call Writedata
 A = &H87                                                    'horizontal character size=8
 Call Writedata
 A = &H07                                                    'vertical character size=8
 Call Writedata
 A = &H27                                                    'display addresses per line
 Call Writedata
 A = &H50                                                    'total address range per line
 Call Writedata
 A = &HEF                                                    '240 display lines
 Call Writedata
 A = &H28                                                    'virtual address1
 Call Writedata
 A = &H00                                                    'virtual address2
 Call Writedata
 A = &H44                                                    'scroll
 Call Writecom
 A = &H00                                                    'start address1
 Call Writedata
 A = &H00                                                    'start address2
 Call Writedata
 A = &HEF                                                    '240 lines
 Call Writedata
 A = &HB0                                                    '2nd screen start1
 Call Writedata
 A = &H04                                                    '2nd screen start2
 Call Writedata
 A = &HEF                                                    '2nd screen 240 lines
 Call Writedata
 A = &H00                                                    '3rd screen address1
 Call Writedata
 A = &H00                                                    '3rd screen address2
 Call Writedata
```

```
 A = &H00                                                    '4th screen address1
 Call Writedata
 A = &H00                                                    '4th screen address2
 Call Writedata
 A = &H5A                                                    'hdot scr
 Call Writecom
 A = &H00                                                    'horizontal pixel shift=0
 Call Writedata
 A = &H5B                                                    'overlay
 Call Writecom
 A = &H00                                                    'OR
 Call Writedata
 A = &H5D                                                    'cursor form
 Call Writecom
 A = &H04                                                    '5 pixels
 Call Writedata
 A = &H86                                                    'by 7 pixels
 Call Writedata
 A = &H4C                                                    'cursor direction = right
 Call Writecom

 Call Clr                                                    'clear the screen

 A = &H59                                                    'disp on/off
 Call Writecom
 A = &H14                                                    'on
 Call Writedata
End Sub
//---------------------------------------------------------------------------
```

## 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

## Warranty Information and Terms & Conditions

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

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(Применяются в военной, авиационной, аэрокосмической, морской, железнодорожной, горно- и нефтедобывающей отраслях промышленности)

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Телефон: 8 (812) 309-75-97 (многоканальный)
Факс: 8 (812) 320-03-32
Электронная почта: ocean@oceanchips.ru
Web: http://oceanchips.ru/
Адрес: 198099, г. Санкт-Петербург, ул. Калинина, д. 2, корп. 4, лит. А