

# NHD-240128BZ-NSW-BTW

## Graphic Liquid Crystal Display Module

|         |                                  |
|---------|----------------------------------|
| NHD-    | Newhaven Display                 |
| 240128- | 240 x 128 pixels                 |
| BZ-     | Model                            |
| N-      | Transmissive                     |
| SW-     | Side White LED Backlight         |
| B-      | STN - Blue (-)                   |
| T-      | 12:00 view                       |
| W-      | Wide Temperature (-20°C ~ +70°C) |
|         | <b>RoHS Compliant</b>            |

### **Newhaven Display International, Inc.**

2511 Technology Drive, Suite 101

Elgin IL, 60124

Ph: 847-844-8795

Fax: 847-844-8796

[www.newhavendisplay.com](http://www.newhavendisplay.com)

[nhtech@newhavendisplay.com](mailto:nhtech@newhavendisplay.com)

[nhsales@newhavendisplay.com](mailto:nhsales@newhavendisplay.com)

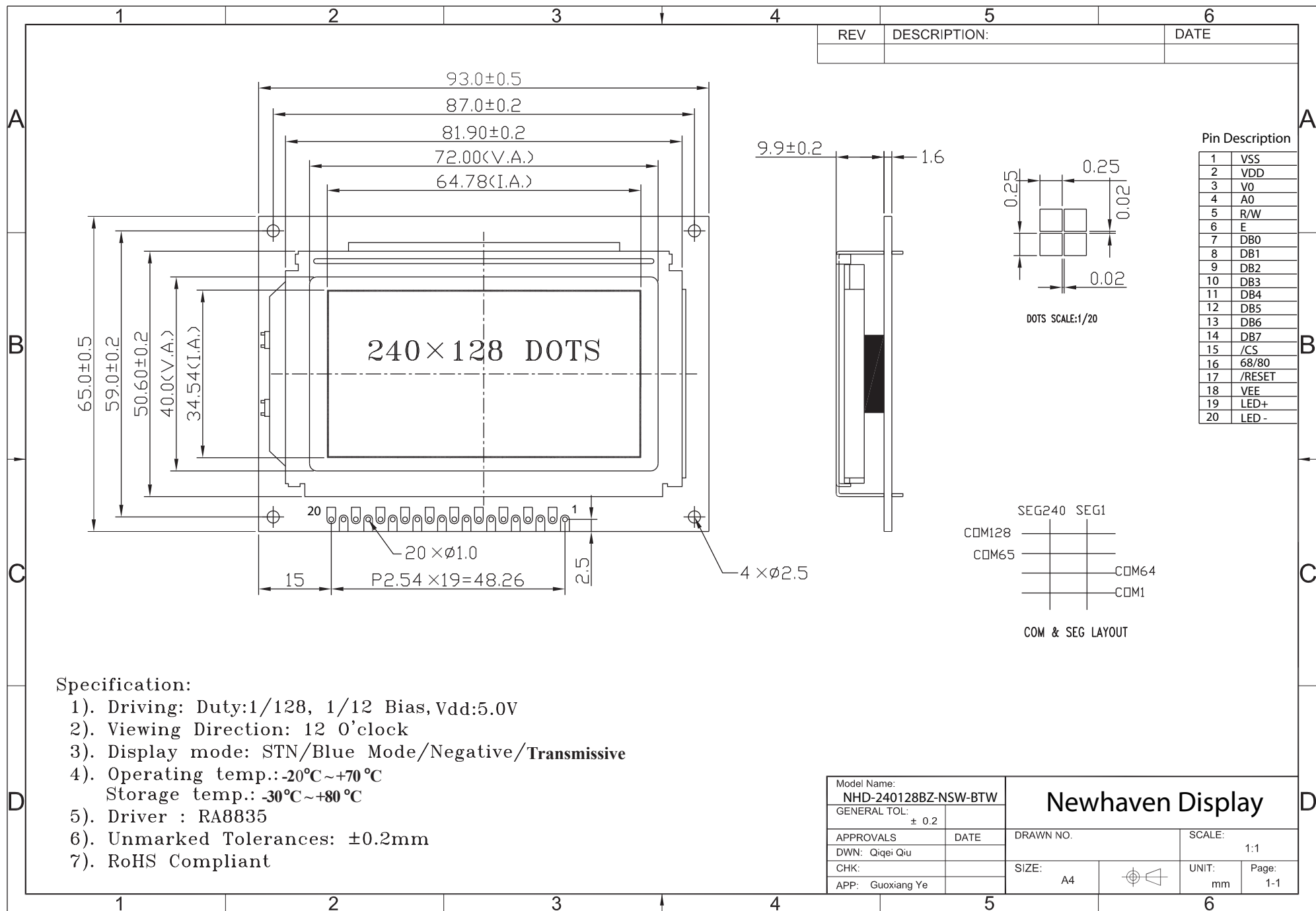
## Document Revision History

| Revision | Date       | Description                                              | Changed by |
|----------|------------|----------------------------------------------------------|------------|
| 0        | 10/5/2007  | Initial Release                                          | -          |
| 1        | 6/4/2008   | Update table of contents                                 | CL         |
| 2        | 4/22/2010  | User guide reformat                                      | BE         |
| 3        | 9/20/2010  | Pin description pin18/electrical characteristics updated | BE         |
| 4        | 11/30/2010 | Update Mechanical Drawing / Block Diagram                | AK         |
| 5        | 6/13/2011  | Electrical characteristics/contrast updated              | BE         |
| 6        | 1/24/2012  | Pin description updated                                  | AK         |

## Functions and Features

- 240 x 128 pixels
- Built-in RA8835 controller
- +5.0V Power Supply
- 1/128 duty, 1/12 bias
- RoHS Compliant

# Mechanical Drawing

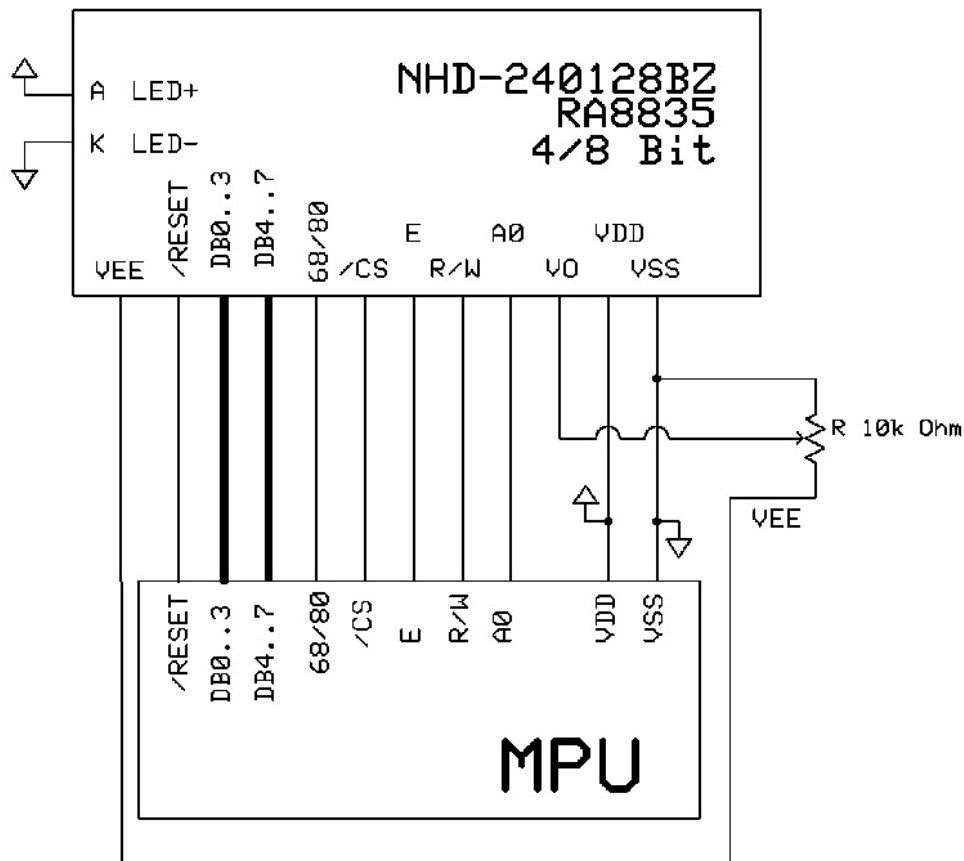


## Pin Description and Wiring Diagram

| 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 19.2V)                                                                  |
| 4       | A0      | MPU                 | Register Select signal. 0: data; 1: instruction                                                           |
| 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      | /CS     | MPU                 | Active LOW Chip Select Signal                                                                             |
| 16      | 68/80   | MPU                 | Interface Select Pin. 0: 8080 Family 1: 6800 Family                                                       |
| 17      | /RESET  | MPU                 | Active LOW reset signal                                                                                   |
| 18      | VEE     | Power Supply        | Positive voltage supply output (+20V)                                                                     |
| 19      | LED+    | Power Supply        | Power supply for LED Backlight (+3.0V)                                                                    |
| 20      | 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    |              | 4.7  | 5.0   | 5.5  | V    |
| Supply Current              | IDD    | VDD=5.0V     | -    | 3.5   | 5.5  | mA   |
| Supply for LCD (contrast)   | VDD-V0 | Ta=25°       | -    | -14.2 | -    | 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    | -    | 36    | -    | mA   |

## Optical Characteristics

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

## Controller Information

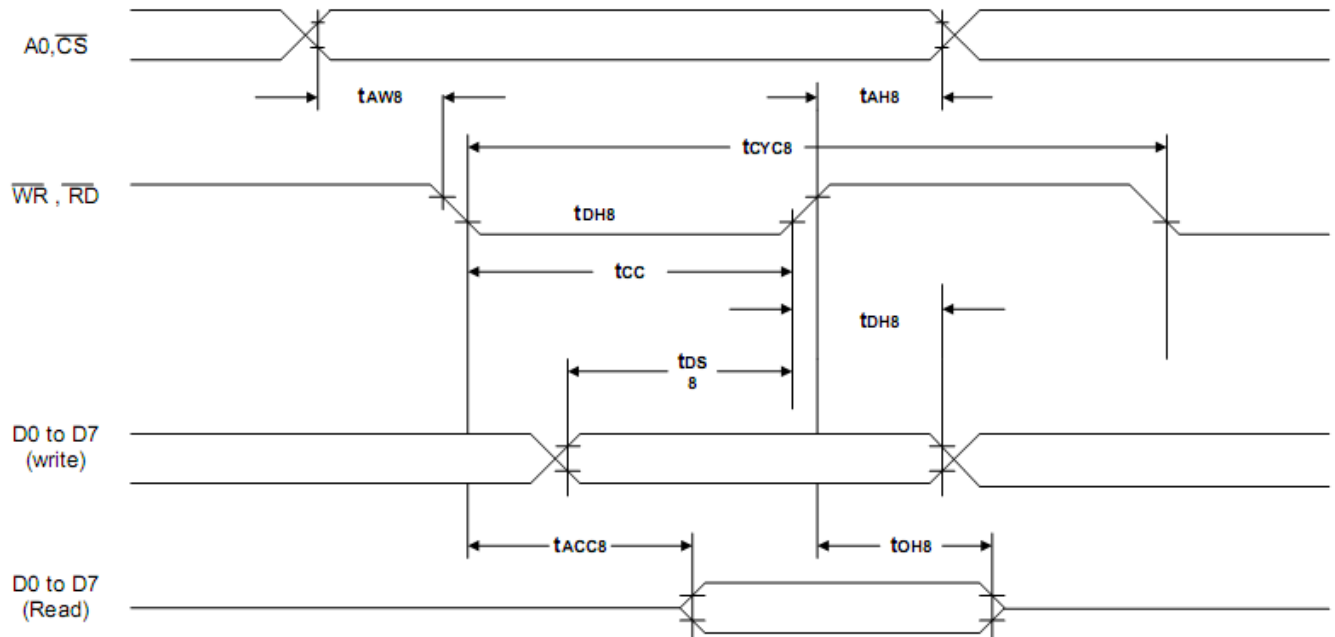
Built-in RA8835. Download specification at [http://www.newhavendisplay.com/app\\_notes/RA8835.pdf](http://www.newhavendisplay.com/app_notes/RA8835.pdf)

## Table of Commands

| Class           | Command        | Code |    |    |    |    |    |    |    |    |      |      |              | Hex                                             | Command Description | Command Read Parameters |  |
|-----------------|----------------|------|----|----|----|----|----|----|----|----|------|------|--------------|-------------------------------------------------|---------------------|-------------------------|--|
|                 |                | RD   | WR | A0 | D7 | D6 | D5 | D4 | D3 | D2 | D1   | D0   | No. of Bytes |                                                 |                     | Section                 |  |
| System Control  | SYSTEM SET     | 1    | 0  | 1  | 0  | 1  | 0  | 0  | 0  | 0  | 0    | 0    | 40           | Initialize device and display                   | 8                   | 9-2-1                   |  |
|                 | SLEEP IN       | 1    | 0  | 1  | 0  | 1  | 0  | 1  | 0  | 0  | 1    | 1    | 53           | Enter standby mode                              | 0                   | 9-2-2                   |  |
| Display Control | DISPLAY ON/OFF | 1    | 0  | 1  | 0  | 1  | 0  | 1  | 1  | 0  | 0    | D    | 58, 59       | Enable and disable display and display flashing | 1                   | 9-3-1                   |  |
|                 | SCROLL         | 1    | 0  | 1  | 0  | 1  | 0  | 0  | 0  | 1  | 0    | 0    | 44           | Set display start address and display regions   | 10                  | 9-3-2                   |  |
|                 | CSRFORM        | 1    | 0  | 1  | 0  | 1  | 0  | 1  | 1  | 1  | 0    | 1    | 5D           | Set cursor type                                 | 2                   | 9-3-3                   |  |
|                 | CGRAM ADR      | 1    | 0  | 1  | 0  | 1  | 0  | 1  | 1  | 1  | 0    | 0    | 5C           | Set start address of character generator RAM    | 2                   | 9-3-6                   |  |
|                 | CSRDIR         | 1    | 0  | 1  | 0  | 1  | 0  | 0  | 1  | 1  | CD 1 | CD 0 | 4C to 4F     | Set direction of cursor movement                | 0                   | 9-3-4                   |  |
|                 | HDOT SCR       | 1    | 0  | 1  | 0  | 1  | 0  | 1  | 1  | 0  | 1    | 0    | 5A           | Set horizontal scroll position                  | 1                   | 9-3-7                   |  |
|                 | OVLAY          | 1    | 0  | 1  | 0  | 1  | 0  | 1  | 1  | 0  | 1    | 1    | 5B           | Set display overlay format                      | 1                   | 9-3-5                   |  |
| Drawing Control | CSRW           | 1    | 0  | 1  | 0  | 1  | 0  | 0  | 0  | 1  | 1    | 0    | 46           | Set cursor address                              | 2                   | 9-r1                    |  |
|                 | CSRR           | 1    | 0  | 1  | 0  | 1  | 0  | 0  | 0  | 1  | 1    | 1    | 47           | Read cursor address                             | 2                   | 9-4-2                   |  |
| Memory Control  | MWRITE         | 1    | 0  | 1  | 0  | 1  | 0  | 0  | 0  | 0  | 1    | 0    | 42           | Write to display memory                         | —                   | 9-5-1                   |  |
|                 | MREAD          | 1    | 0  | 1  | 0  | 1  | 0  | 0  | 0  | 0  | 1    | 1    | 43           | Read from display memory                        | —                   | 9-5-2                   |  |

## Timing Characteristics

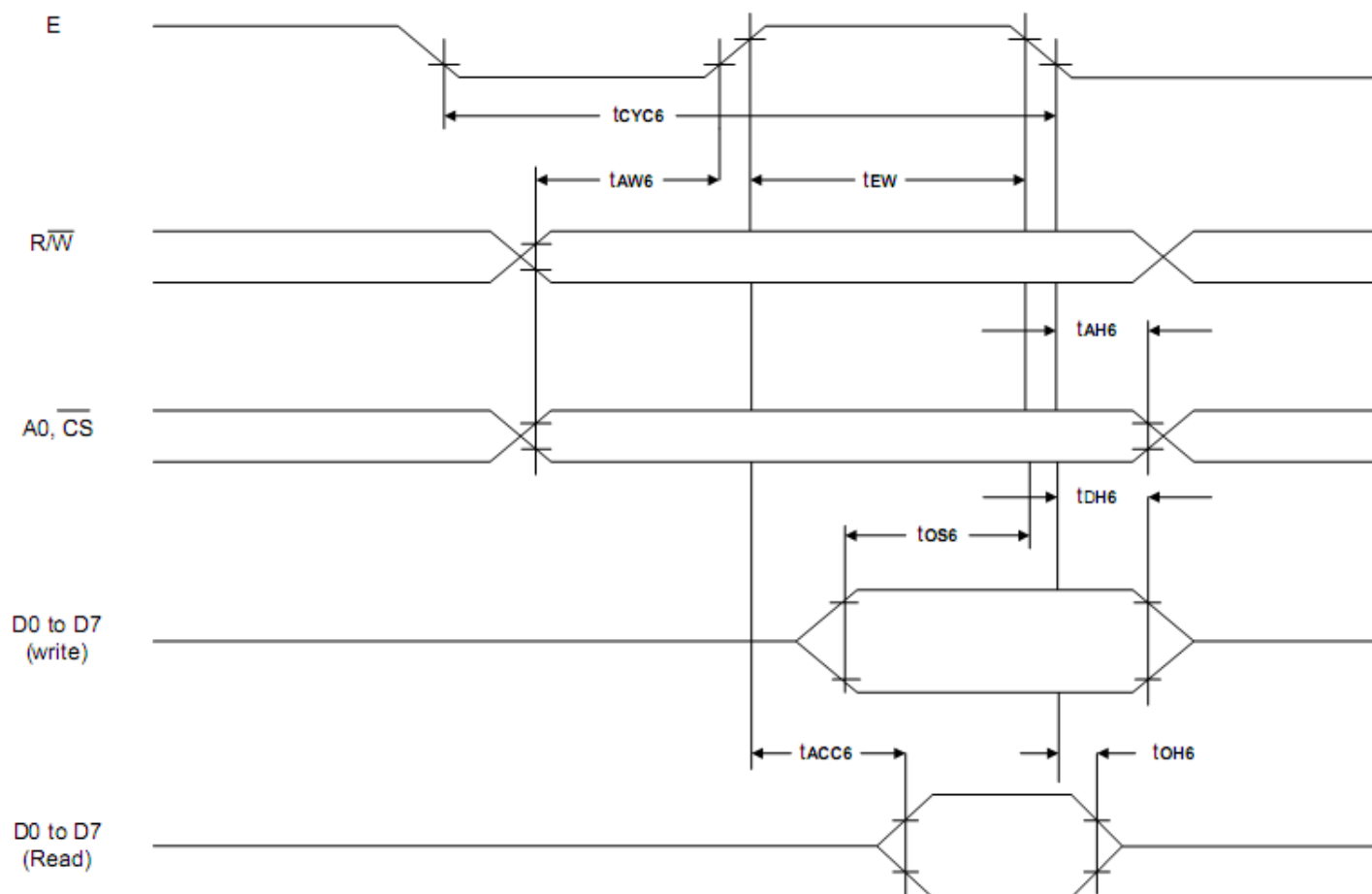
### 10-3-1 8080 Family Interface Timing



$T_a = -20 \text{ to } 75^\circ\text{C}$

| Signal                         | Symbol     | Parameter                   | $V_{DD} = 4.5 \text{ to } 5.5\text{V}$ |      | $V_{DD} = 2.7 \text{ to } 4.5\text{V}$ |      | Unit | Condition  |
|--------------------------------|------------|-----------------------------|----------------------------------------|------|----------------------------------------|------|------|------------|
|                                |            |                             | Min.                                   | Max. | Min.                                   | Max. |      |            |
| $A0, \overline{CS}$            | $t_{AH8}$  | Address hold time           | 10                                     | —    | 10                                     | —    | ns   | CL = 100pF |
|                                | $t_{AW8}$  | Address setup time          | 0                                      | —    | 0                                      | —    | ns   |            |
| $\overline{WR}, \overline{RD}$ | $t_{CYC8}$ | System cycle time           | note.                                  | —    | note.                                  | —    | ns   |            |
|                                | $t_{CC}$   | Strobe pulse width          | 120                                    | —    | 150                                    | —    | ns   |            |
| D0 to D7                       | $t_{DS8}$  | Data setup time             | 120                                    | —    | 120                                    | —    | ns   |            |
|                                | $t_{DH8}$  | Data hold time              | 5                                      | —    | 5                                      | —    | ns   |            |
|                                | $t_{ACC8}$ | $\overline{RD}$ access time | —                                      | 50   | —                                      | 80   | ns   |            |
|                                | $t_{OH8}$  | Output disable time         | 10                                     | 50   | 10                                     | 55   | ns   |            |

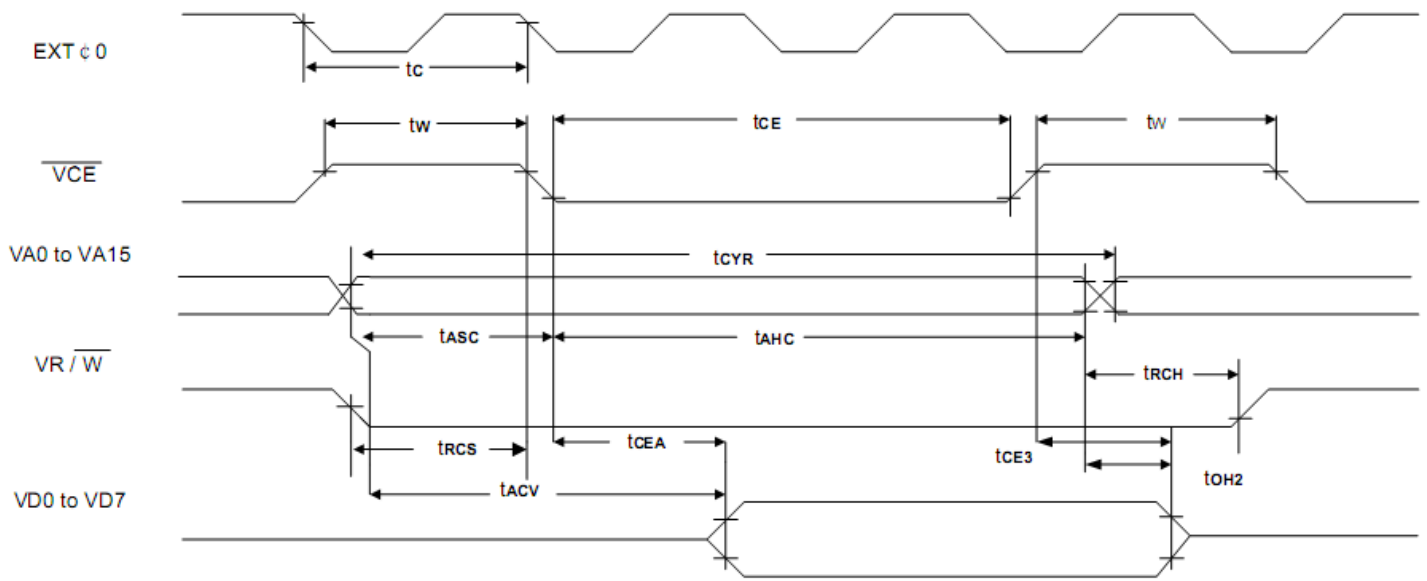
## 6800 Family Interface Timing



$T_a = -20 \text{ to } 75^\circ\text{C}$

| Signal                                | Symbol     | Parameter           | $V_{DD} = 4.5 \text{ to } 5.5\text{V}$ |      | $V_{DD} = 2.7 \text{ to } 4.5\text{V}$ |      | Unit | Condition      |
|---------------------------------------|------------|---------------------|----------------------------------------|------|----------------------------------------|------|------|----------------|
|                                       |            |                     | Min.                                   | Max. | Min.                                   | Max. |      |                |
| A0, $\overline{\text{CS}}$ ,<br>R/(W) | $t_{CYC6}$ | System cycle time   | note.                                  | —    | note.                                  | —    | ns   | CL = 100<br>pF |
|                                       | $t_{AW6}$  | Address setup time  | 0                                      | —    | 10                                     | —    | ns   |                |
|                                       | $t_{AH6}$  | Address hold time   | 0                                      | —    | 0                                      | —    | ns   |                |
| D0 to D7                              | $t_{DS6}$  | Data setup time     | 100                                    | —    | 120                                    | —    | ns   |                |
|                                       | $t_{DH6}$  | Data hold time      | 0                                      | —    | 0                                      | —    | ns   |                |
|                                       | $t_{OH6}$  | Output disable time | 10                                     | 50   | 10                                     | 75   | ns   |                |
|                                       | $t_{ACC6}$ | Access time         | —                                      | 85   | —                                      | 130  | ns   |                |
| E                                     | $t_{EW}$   | Enable pulse width  | 120                                    | —    | 150                                    | —    | ns   |                |

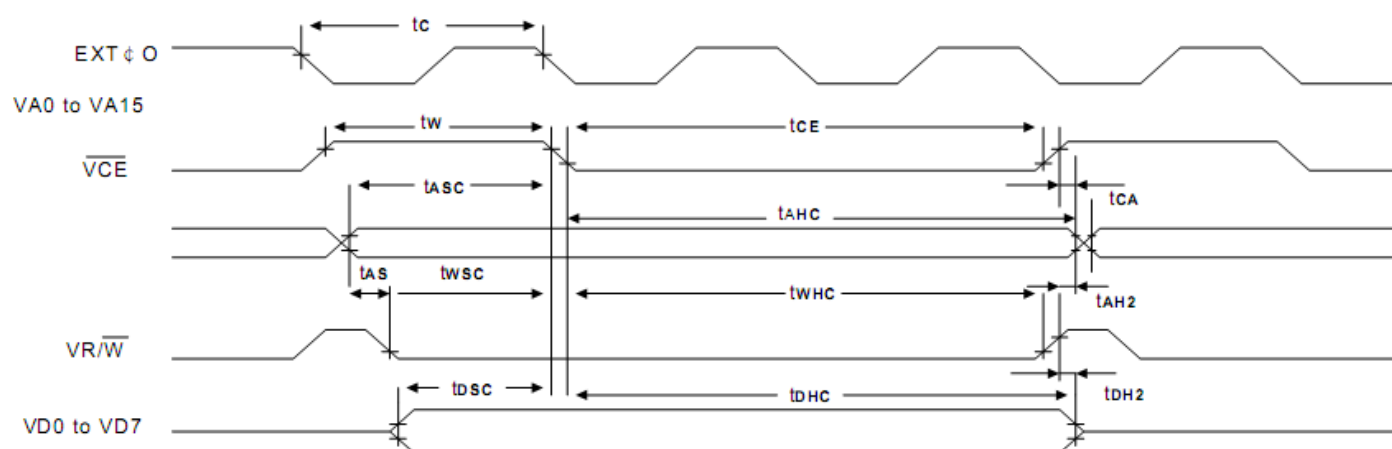
## Display Memory Read Timing



$T_a = -20 \text{ to } 75^\circ\text{C}$

| Signal                  | Symbol    | Parameter                                                        | $V_{DD} = 4.5 \text{ to } 5.5\text{V}$ |              | $V_{DD} = 2.7 \text{ to } 4.5\text{V}$ |              | Unit | Condition   |
|-------------------------|-----------|------------------------------------------------------------------|----------------------------------------|--------------|----------------------------------------|--------------|------|-------------|
|                         |           |                                                                  | Min.                                   | Max.         | Min.                                   | Max.         |      |             |
| EXT $\Phi 0$            | $t_c$     | Clock period                                                     | 100                                    | —            | 125                                    | —            | ns   | CL = 100 pF |
| $\overline{\text{VCE}}$ | $t_w$     | VCE HIGH-level pulse width                                       | $t_c - 50$                             | —            | $t_c - 50$                             | —            | ns   |             |
|                         | $t_{CE}$  | VCE LOW-level pulse width                                        | $2t_c - 30$                            | —            | $2t_c - 30$                            | —            | ns   |             |
| VA0 to VA15             | $t_{CYR}$ | Read cycle time                                                  | $3t_c$                                 | —            | $3t_c$                                 | —            | ns   |             |
|                         | $t_{ASC}$ | Address setup time to falling edge of $\overline{\text{VCE}}$    | $t_c - 70$                             | —            | $t_c - 100$                            | —            | ns   |             |
|                         | $t_{AHC}$ | Address hold time from falling edge of $\overline{\text{VCE}}$   | $2t_c - 30$                            | —            | $2t_c - 40$                            | —            | ns   |             |
| $\overline{\text{VRD}}$ | $t_{RCS}$ | Read cycle setup time to falling edge of $\overline{\text{VCE}}$ | $t_c - 45$                             | —            | $t_c - 60$                             | —            | ns   |             |
|                         | $t_{RCH}$ | Read cycle hold time from rising edge of $\overline{\text{VCE}}$ | $0.5t_c$                               | —            | $0.5t_c$                               | —            | ns   |             |
| VD0 to VD7              | $t_{ACV}$ | Address access time                                              | —                                      | $3t_c - 100$ | —                                      | $3t_c - 115$ | Ns   |             |
|                         | $t_{CEA}$ | VCE access time                                                  | —                                      | $2t_c - 80$  | —                                      | $2t_c - 90$  | Ns   |             |
|                         | $t_{OH2}$ | Output data hold time                                            | 0                                      | —            | 0                                      | —            | ns   |             |
|                         | $t_{CE3}$ | VCE to data off time                                             | 0                                      | —            | 0                                      | —            | ns   |             |

## Display Memory Write Timing



Ta = -20 to 75°C

| Signal                  | Symbol           | Parameter                                                         | V <sub>DD</sub> = 4.5 to 5.5V |      | V <sub>DD</sub> = 2.7 to 4.5V |      | Unit | Condition   |
|-------------------------|------------------|-------------------------------------------------------------------|-------------------------------|------|-------------------------------|------|------|-------------|
|                         |                  |                                                                   | Min.                          | Max. | Min.                          | Max. |      |             |
| EXT Φ0                  | t <sub>c</sub>   | Clock period                                                      | 100                           | —    | 125                           | —    | ns   | CL = 100 pF |
| $\overline{\text{VCE}}$ | t <sub>w</sub>   | VCE HIGH-level pulse width                                        | t <sub>c</sub> - 50           | —    | t <sub>c</sub> - 50           | —    | ns   |             |
|                         | t <sub>ce</sub>  | VCE LOW-level pulse width                                         | 2t <sub>c</sub> - 30          | —    | 2t <sub>c</sub> - 30          | —    | ns   |             |
| VA0 to VA15             | t <sub>cyw</sub> | Write cycle time                                                  | 3t <sub>c</sub>               | —    | 3t <sub>c</sub>               | —    | ns   |             |
|                         | t <sub>AHC</sub> | Address hold time from falling edge of $\overline{\text{VCE}}$    | 2t <sub>c</sub> - 30          | —    | 2t <sub>c</sub> - 40          | —    | ns   |             |
|                         | t <sub>ASC</sub> | Address setup time to falling edge of $\overline{\text{VCE}}$     | t <sub>c</sub> - 70           | —    | t <sub>c</sub> - 110          | —    | ns   |             |
|                         | t <sub>CA</sub>  | Address hold time from rising edge of $\overline{\text{VCE}}$     | 0                             | —    | 0                             | —    | ns   |             |
|                         | t <sub>AS</sub>  | Address setup time to falling edge of $\overline{\text{VWR}}$     | 0                             | —    | 0                             | —    | ns   |             |
|                         | t <sub>AH2</sub> | Address hold time from rising edge of $\overline{\text{VWR}}$     | 10                            | —    | 10                            | —    | ns   |             |
| $\overline{\text{VWR}}$ | t <sub>WSC</sub> | Write setup time to falling edge of $\overline{\text{VCE}}$       | t <sub>c</sub> - 80           | —    | t <sub>c</sub> - 115          | —    | ns   |             |
|                         | t <sub>WHC</sub> | Write hold time from falling edge of $\overline{\text{VCE}}$      | 2t <sub>c</sub> - 20          | —    | 2t <sub>c</sub> - 20          | —    | ns   |             |
| VD0 to VD7              | t <sub>DSC</sub> | Data input setup time to falling edge of $\overline{\text{VCE}}$  | t <sub>c</sub> - 85           | —    | t <sub>c</sub> - 125          | —    | ns   |             |
|                         | t <sub>DHC</sub> | Data input hold time from falling edge of $\overline{\text{VCE}}$ | 2t <sub>c</sub> - 30          | —    | 2t <sub>c</sub> - 30          | —    | ns   |             |

# Example Initialization Program

```
//-----
sbit A0 = P3^0;
sbit RW = P3^7;
sbit E = P3^4;
sbit CS = P3^1;
sbit IM = P3^6;
sbit RST = P3^2;

//-----
void Writecom(int A)
{
    CS = 0;
    RW = 0;
    A0 = 1;
    E = 1;
    P1 = A;
    E = 1;
}

void Write(int A)
{
    CS = 0;
    RW = 0;
    A0 = 0;
    E = 1;
    P1 = A;
    E = 1;
}

//-----
void init()
{
    IM = 1;
    RST = 0;
    delay(10);
    RST = 1;
    delay(100);
    Writecom(0x40);
    Write(0x30);
    Write(0x87);
    Write(0x07);
    Write(0x1D);
    Write(0x50);
    Write(0x80);
    Write(0x1E);
    Write(0x00);
    Writecom(0x44);
    Write(0x00);
    Write(0x00);
    Write(0x80);
    Write(0x00);
    Write(0x40);
    Write(0x80);
    Write(0x00);
    Write(0x00);
    Write(0x00);
    Write(0x00);
    Write(0x00);
    Write(0x5A);
    Write(0x00);
    Write(0x5B);
    Write(0x0C);
    Write(0x4C);
    Write(0x46);
}
```

```
Write(0xB0);
Write(0xB0);
Write(0x42);
Write(0x00);

for(a = 0; a < 3840; a++)
{
    Write(0x00);
}
Writecom(0x46);
Write(0x60);
Write(0x09);
Writecom(0x42);
Write(0x00);
for(a = 0; a < 3840; a++)
{
    Write(0x00);
}
Writecom(0x59);
Write(0x04);
}
//-----
```

## 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](http://www.newhavendisplay.com/specs/precautions.pdf)

## Warranty Information and Terms & Conditions

[http://www.newhavendisplay.com/index.php?main\\_page=terms](http://www.newhavendisplay.com/index.php?main_page=terms)