

# NHD-320240WX-CoTFH-V#I041

## Graphic Liquid Crystal Display Module

|         |   |
|---------|---|
| NHD-    | Newhaven Display  |
| 320240- | 320 x 240 pixels  |
| WX-     | Display Type: Graphic                                     |
| Co-     | Model   |
| T-      | White LED Backlight                                       |
| F-      | FSTN (+)  |
| H-      | Transflective, 6:00 view, Wide Temperature (-20°C ~+70°C) |
| V#-     | Built-in Positive Voltage                                 |
| I041-   | IST Driver, with mounting holes                           |

**RoHS Compliant**

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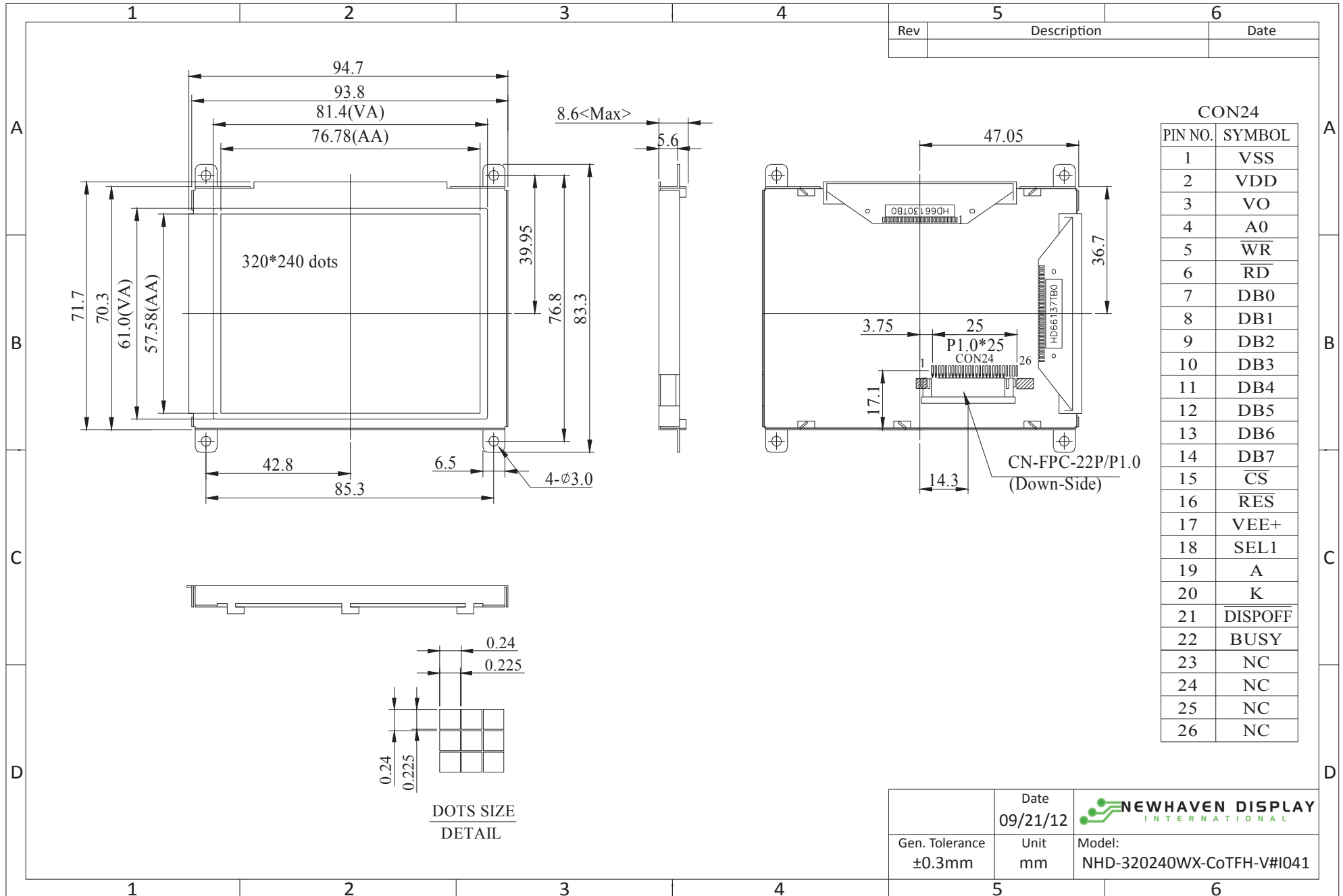
## Document Revision History

| Revision | Date      | Description  | Changed by |
|----------|-----------|--|------------|
| 0        | 6/7/2007  | Initial Release  | -          |
| 1        | 4/23/2010 | User guide reformat  | MC         |
| 2        | 5/25/2010 | Contrast revised   | BE         |
| 3        | 6/3/2010  | Backlight Supply Current updated   | MC         |
| 4        | 2/3/2011  | Pin description/block diagram updated  | AK         |
| 5        | 2/4/2011  | Drawing/pin description/block diagram updated  | AK         |
| 6        | 9/21/2012 | Drawing/electrical and optical characteristics/block diagram/table of commands updated | JN         |

### Functions and Features

- 320 x 240 pixels
- Built-in RA8835 Controller
- +3.3V power supply
- RoHS Compliant

# Mechanical Drawing



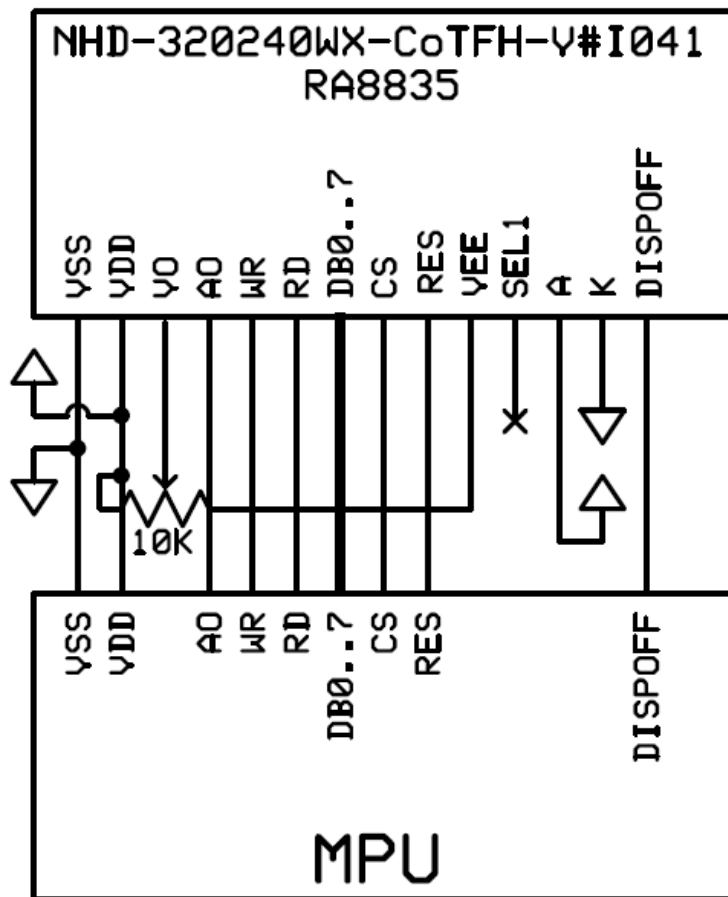
## Pin Description and Wiring Diagram

| Pin No. | Symbol  | External Connection | Function Description                                 |
|---------|---------|---------------------|--|
| 1       | VSS     | Power Supply        | Ground   |
| 2       | VDD     | Power Supply        | Power supply for logic (+3.3V)                       |
| 3       | VO      | Adj Power Supply    | Power supply for contrast (approx. +18.7V)           |
| 4       | A0      | MPU                 | Register select signal. A0=0: Command, A0=1: Data    |
| 5       | WR      | MPU                 | Read/Write select signal, R/W=1: Read R/W: =0: Write |
| 6       | RD      | MPU                 | Active LOW read                                      |
| 7-14    | DB0-DB7 | MPU                 | Bi-directional three-state data bus lines.           |
| 15      | CS      | MPU                 | Active LOW chip select                               |
| 16      | RES     | MPU                 | Active LOW reset signal                              |
| 17      | VEE+    | Power Supply        | Positive voltage output (+28V)                       |
| 18      | SEL1    | NC                  | No Connect (selected by on-board jumper JSEL)        |
| 19      | LED+    | Power Supply        | Power Supply for LED Backlight (+3.5V)               |
| 20      | LED-    | Power Supply        | Ground for Backlight                                 |
| 21      | DISPOFF | Power Supply        | Active LOW display off signal.                       |
| 22      | NC      | -                   | No Connect   |

**Recommended LCD connector:** 22 pin, 1.0mm pitch FFC Connector

**Backlight connector:** On LCD 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    | -                 | 3.0     | 3.3    | 3.6     | V    |
| Supply Current              | IDD    | Ta=25°C, VDD=3.3V | -       | 33     | -       | mA   |
| Supply for LCD (contrast)   | V0     | Ta=25°C           | 21.1    | 21.7   | 22.3    | V    |
| "H" Level input             | VIH    | -                 | 0.5*VDD | -      | VDD     | V    |
| "L" Level input             | VIL    | -                 | VSS     | -      | 0.2*VDD | V    |
| "H" Level output            | VOH    | -                 | 2.4     | -      | -       | 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         | 72      | 82     | 120     | mA   |
| Backlight Lifetime          | -      | ILED≤82mA         | -       | 50,000 | -       | Hrs  |

## Optical Characteristics

| Item                   | Symbol | Condition | Min. | Typ. | Max. | Unit |
|------------------------|--------|-----------|------|------|------|------|
| Viewing Angle - Top    |        | Cr ≥ 2    | -    | 30   | -    | °    |
| Viewing Angle - Bottom |        |           | -    | 60   | -    | °    |
| Viewing Angle - Left   |        |           | -    | 45   | -    | °    |
| Viewing Angle - Right  |        |           | -    | 45   | -    | °    |
| Contrast Ratio         | Cr     | -         | -    | 5    | -    | -    |
| Response Time (rise)   | Tr     | -         | -    | 200  | 300  | ms   |
| Response Time (fall)   | Tf     | -         | -    | 150  | 200  | ms   |

## Controller Information

Built-in RA8835 controller.

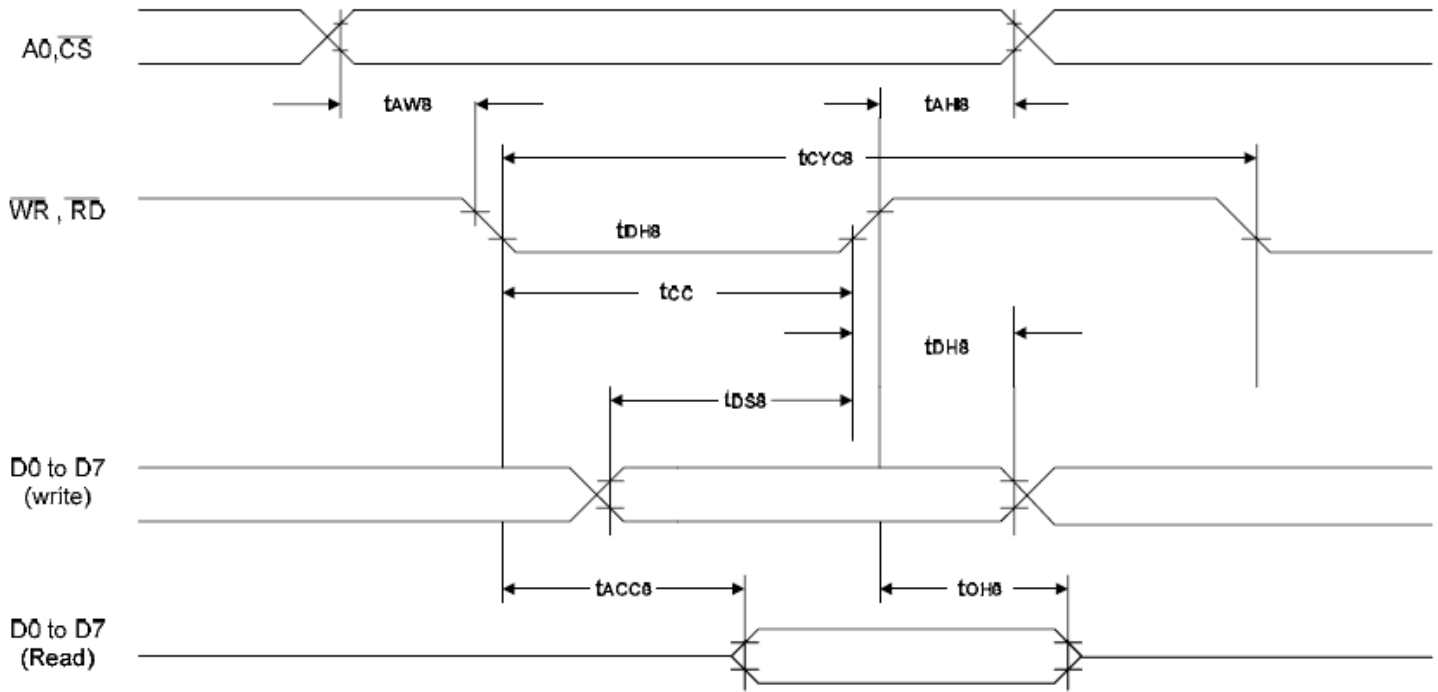
Please download specification at [http://www.newhavendisplay.com/app\\_notes/RA8835.pdf](http://www.newhavendisplay.com/app_notes/RA8835.pdf)

## 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  | <b>SYSTEM SET</b>     | 1    | 0  | 1  | 0  | 1  | 0  | 0  | 0  | 0  | 0       | 0       | 40       | Initialize device and display                   | 8                       | 6-2-1   |
|                 | <b>SLEEP IN</b>       | 1    | 0  | 1  | 0  | 1  | 0  | 1  | 0  | 0  | 1       | 1       | 53       | Enter standby mode                              | 0                       | 6-2-2   |
| Display Control | <b>DISPLAY ON/OFF</b> | 1    | 0  | 1  | 0  | 1  | 0  | 1  | 1  | 0  | 0       | D       | 58, 59   | Enable and disable display and display flashing | 1                       | 6-3-1   |
|                 | <b>SCROLL</b>         | 1    | 0  | 1  | 0  | 1  | 0  | 0  | 0  | 1  | 0       | 0       | 44       | Set display start address and display regions   | 10                      | 6-3-2   |
|                 | <b>CSRFORM</b>        | 1    | 0  | 1  | 0  | 1  | 0  | 1  | 1  | 1  | 0       | 1       | 5D       | Set cursor type                                 | 2                       | 6-3-3   |
|                 | <b>CGRAM ADR</b>      | 1    | 0  | 1  | 0  | 1  | 0  | 1  | 1  | 1  | 0       | 0       | 5C       | Set start address of character generator RAM    | 2                       | 6-3-6   |
|                 | <b>CSRDIR</b>         | 1    | 0  | 1  | 0  | 1  | 0  | 0  | 1  | 1  | CD<br>1 | CD<br>0 | 4C to 4F | Set direction of cursor movement                | 0                       | 6-3-4   |
|                 | <b>HDOT SCR</b>       | 1    | 0  | 1  | 0  | 1  | 0  | 1  | 1  | 0  | 1       | 0       | 5A       | Set horizontal scroll position                  | 1                       | 6-3-7   |
|                 | <b>OVLAY</b>          | 1    | 0  | 1  | 0  | 1  | 0  | 1  | 1  | 0  | 1       | 1       | 5B       | Set display overlay format                      | 1                       | 6-3-5   |
| Drawing Control | <b>CSRW</b>           | 1    | 0  | 1  | 0  | 1  | 0  | 0  | 0  | 1  | 1       | 0       | 46       | Set cursor address                              | 2                       | 6-4-1   |
|                 | <b>CSRR</b>           | 1    | 0  | 1  | 0  | 1  | 0  | 0  | 0  | 1  | 1       | 1       | 47       | Read cursor address                             | 2                       | 6-4-2   |
| Memory Control  | <b>MWRITE</b>         | 1    | 0  | 1  | 0  | 1  | 0  | 0  | 0  | 0  | 1       | 0       | 42       | Write to display memory                         | —                       | 6-5-1   |
|                 | <b>MREAD</b>          | 1    | 0  | 1  | 0  | 1  | 0  | 0  | 0  | 0  | 1       | 1       | 43       | Read from display memory                        | —                       | 6-5-2   |

# Timing Characteristics

## 8080 Family Interface Timing



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

| Signal                               | Symbol     | Parameter                   | $V_{DD} = 4.5$ to $5.5\text{V}$ |      | $V_{DD} = 2.7$ 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   |            |
| $\overline{WR}$ ,<br>$\overline{RD}$ | $t_{CYC8}$ | 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   |            |

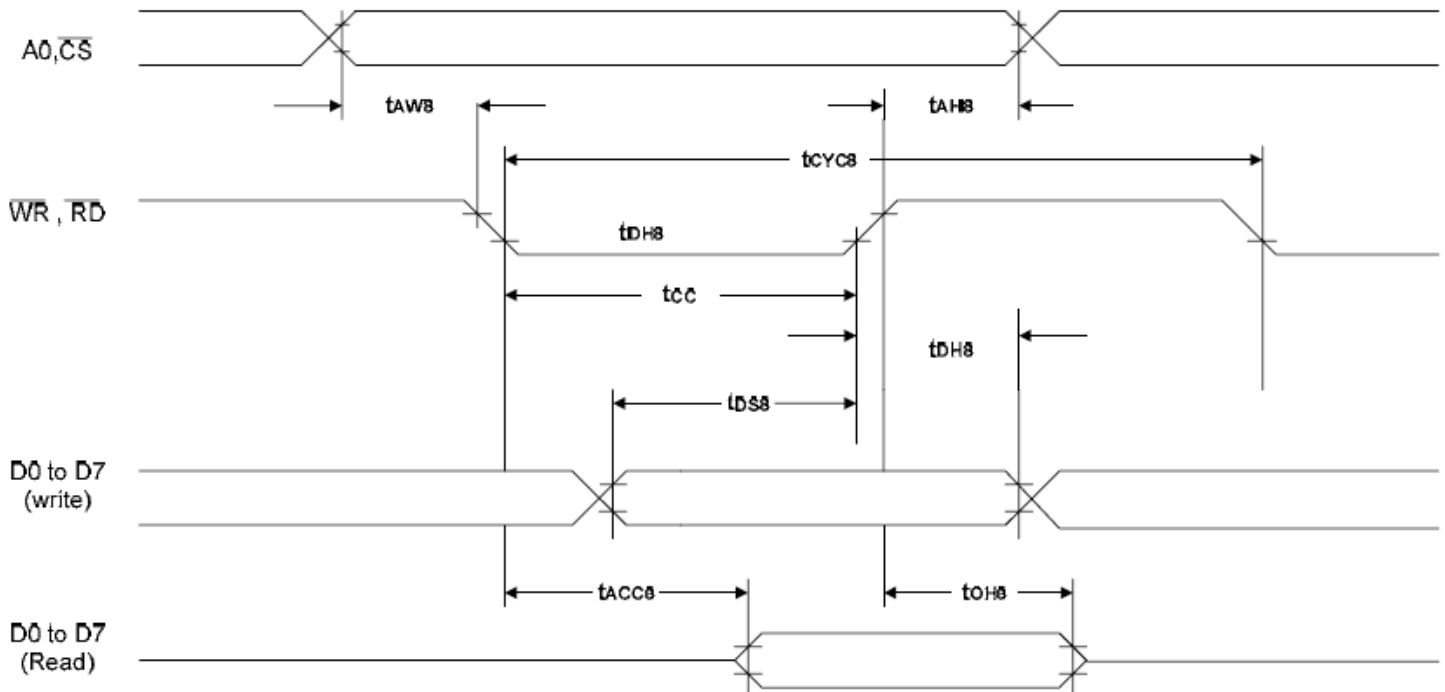
**Note:** For memory control and system control commands:

$$t_{CYC8} = 2t_C + t_{CC} + t_{CEA} + 75 > t_{ACV} + 245$$

For all other commands:

$$t_{CYC8} = 4t_C + t_{CC} + 30$$

## 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) | $t_{\text{CYC6}}$ | System cycle time   | note.                                  | —    | note.                                  | —    | ns   | CL = 100<br>pF |
|                                       | $t_{\text{AW6}}$  | Address setup time  | 0                                      | —    | 10                                     | —    | ns   |                |
|                                       | $t_{\text{AH6}}$  | Address hold time   | 0                                      | —    | 0                                      | —    | ns   |                |
| D0 to D7                              | $t_{\text{DS6}}$  | Data setup time     | 100                                    | —    | 120                                    | —    | ns   |                |
|                                       | $t_{\text{DH6}}$  | Data hold time      | 0                                      | —    | 0                                      | —    | ns   |                |
|                                       | $t_{\text{OH6}}$  | Output disable time | 10                                     | 50   | 10                                     | 75   | ns   |                |
|                                       | $t_{\text{ACC6}}$ | Access time         | —                                      | 85   | —                                      | 130  | ns   |                |
| E                                     | $t_{\text{EW}}$   | Enable pulse width  | 120                                    | —    | 150                                    | —    | ns   |                |

**Note:** For memory control and system control commands:

$$t_{\text{CYC6}} = 2t_{\text{C}} + t_{\text{EW}} + t_{\text{CEA}} + 75 > t_{\text{ACV}} + 245$$

For all other commands:

$$t_{\text{CYC6}} = 4t_{\text{C}} + t_{\text{EW}} + 30$$



## Example Initialization Code

```
//-----  
#define A0 P3_0  
#define RW P3_7  
#define E P3_4  
#define CS P3_1  
#define RESET P3_6  
  
//-----  
void data_out(unsigned char i) //Data Output 16-bit Bus Interface  
{  
    A0 = 0;  
    P1 = i;  
    CS = 0;  
    RW = 0;  
    E = 1;  
    delay(1);  
    E = 0;  
    RW = 1;  
    CS = 1;  
}  
void comm_out(unsigned char j) //Command Output 8-bit Bus Interface  
{  
    A0 = 1;  
    P1 = j;  
    CS = 0;  
    RW = 0;  
    E = 1;  
    delay(1);  
    E = 0;  
    RW = 1;  
    CS = 1;  
}  
  
//-----  
//          Initialization For RA8835  
//-----  
void resetLCD()  
{  
    RESET = 0;  
    delay(5);  
    RESET = 1;  
    delay(10);  
}  
void init_LCD()  
{  
    comm_out(0x40);  
    delay(5);  
    data_out(0x34);
```

```
data_out(0x87);
data_out(0x07);
data_out(0x27);
data_out(0x39);
data_out(0xEF);
data_out(0x28);
data_out(0x00);
comm_out(0x44);
data_out(0x00);
data_out(0x00);
data_out(0xEF);
data_out(0xB0);
data_out(0x04);
data_out(0xEF);
data_out(0x00);
data_out(0x00);
data_out(0x00);
data_out(0x00);
comm_out(0x5A);
data_out(0x00);
comm_out(0x5B);
data_out(0x00);
comm_out(0x58);
data_out(0x56);
comm_out(0x5D);
data_out(0x04);
data_out(0x86);
comm_out(0x4C);
comm_out(0x59);
data_out(0x16);
delay(5);
}
//-----
```

## 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)