

# NHD-14432WG-ATFH-V#T

## Graphic Liquid Crystal Display Module

|        |                                                            |
|--------|------------------------------------------------------------|
| NHD-   | Newhaven Display                                           |
| 14432- | 144 x 32 pixels                                            |
| WG-    | Display type: Graphic                                      |
| A-     | Model                                                      |
| T-     | White LED backlight                                        |
| F-     | FSTN (+)                                                   |
| H-     | Transflective, 6:00 View, Wide Temperature (-20°C ~ +70°C) |
| V#T-   | Built-in Positive Voltage                                  |
|        | <b>RoHS Compliant</b>                                      |

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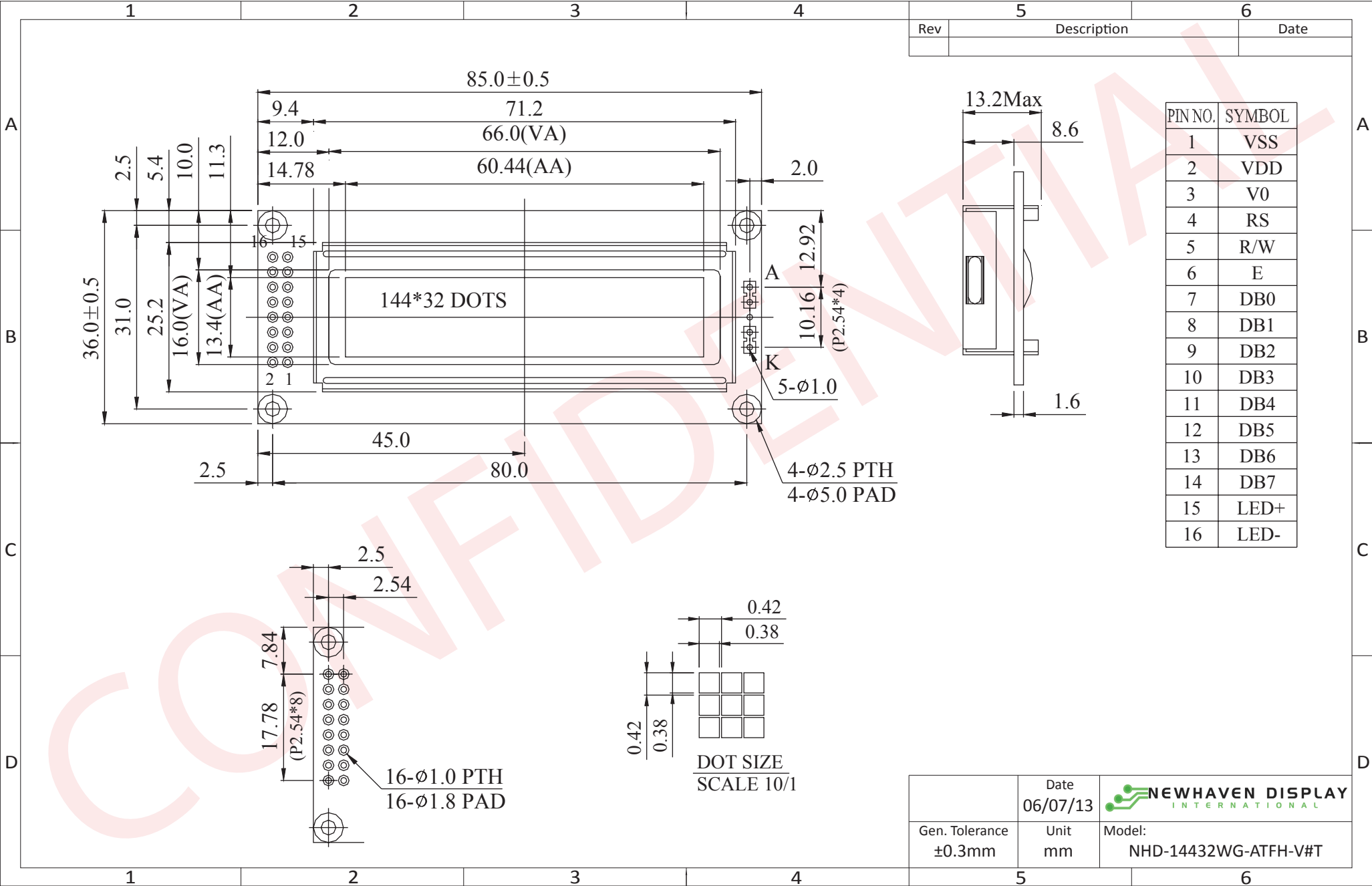
## Document Revision History

| Revision | Date      | Description                  | Changed by |
|----------|-----------|------------------------------|------------|
| 0        | 2/28/2008 | Initial Release              | -          |
| 1        | 4/5/2010  | User guide reformat          | BE         |
| 2        | 5/5/2010  | Updates                      | BE         |
| 3        | 5/10/2010 | BLOCK DIAGRAM UPDATED        | BE         |
| 4        | 5/25/2010 | Contrast updated             | BE         |
| 5        | 6/7/2013  | Controller information added | AK         |

## Functions and Features

- 144x32 pixels
- Built-in ST7920-OC Controller
- +5.0V power supply
- 1/32 duty
- RoHS Compliant

Mechanical Drawing



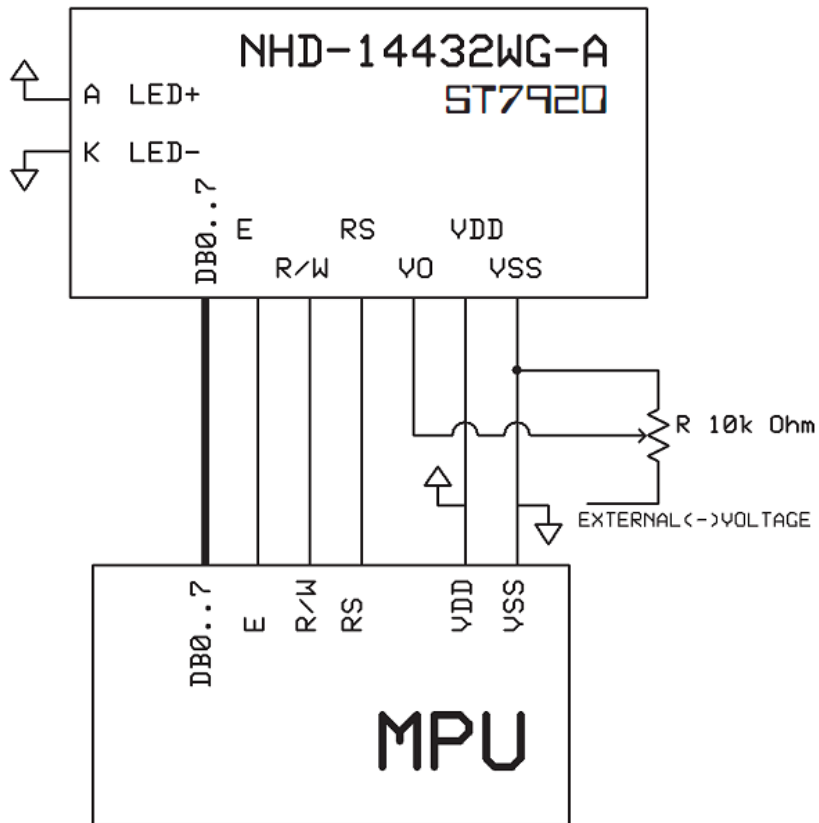
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## Pin Description and Wiring Diagram

| Pin No. | Symbol  | External Connection | Function Description                                 |
|---------|---------|---------------------|------------------------------------------------------|
| 1       | VSS     | Power Supply        | Ground                                               |
| 2       | VDD     | Power Supply        | Power supply for LCD and Logic (+5.0V)               |
| 3       | VO      | Adj Power Supply    | Power Supply for contrast (approx. +4.8V)            |
| 4       | RS      | MPU                 | Register select: 1=Data, 0=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.     |
| 7-14    | DB0-DB7 | MPU                 | 8-bit-directional data bus                           |
| 15      | LED+    | Power Supply        | Power for LED backlight (+3.5V)                      |
| 16      | 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    |                  | 4.5     | 5.0  | 5.5  | V    |
| Supply Current              | IDD    | Ta=25°, VDD=5.0V | 1.6     | 2.2  | 3.5  | mA   |
| Supply for LCD (contrast)   | V0     | Ta=25°           |         | 4.8  |      | V    |
| "H" Level input             | Vih    |                  | 0.7*VDD | -    | VDD  | V    |
| "L" Level input             | Vil    |                  | -0.3    | -    | 0.6  | V    |
| "H" Level output            | Voh    |                  | 0.8*VDD | -    | VDD  | V    |
| "L" Level output            | Vol    |                  | -       | -    | 0.4  | V    |
|                             |        |                  |         |      |      |      |
| Backlight Supply Voltage    | Vled   |                  | -       | 3.5  | 3.9  | V    |
| Backlight Supply Current    | Iled   | Vled=3.5V        | -       | 40   | 80   | mA   |

## 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     |           |      | 200  | 300  | ms   |

## Controller Information

Built-in ST7920-0C.

Please download specification at [http://www.newhavendisplay.com/app\\_notes/ST7920.pdf](http://www.newhavendisplay.com/app_notes/ST7920.pdf)

## Table of Commands

### Instruction Set 1: (RE=0: Basic Instruction)

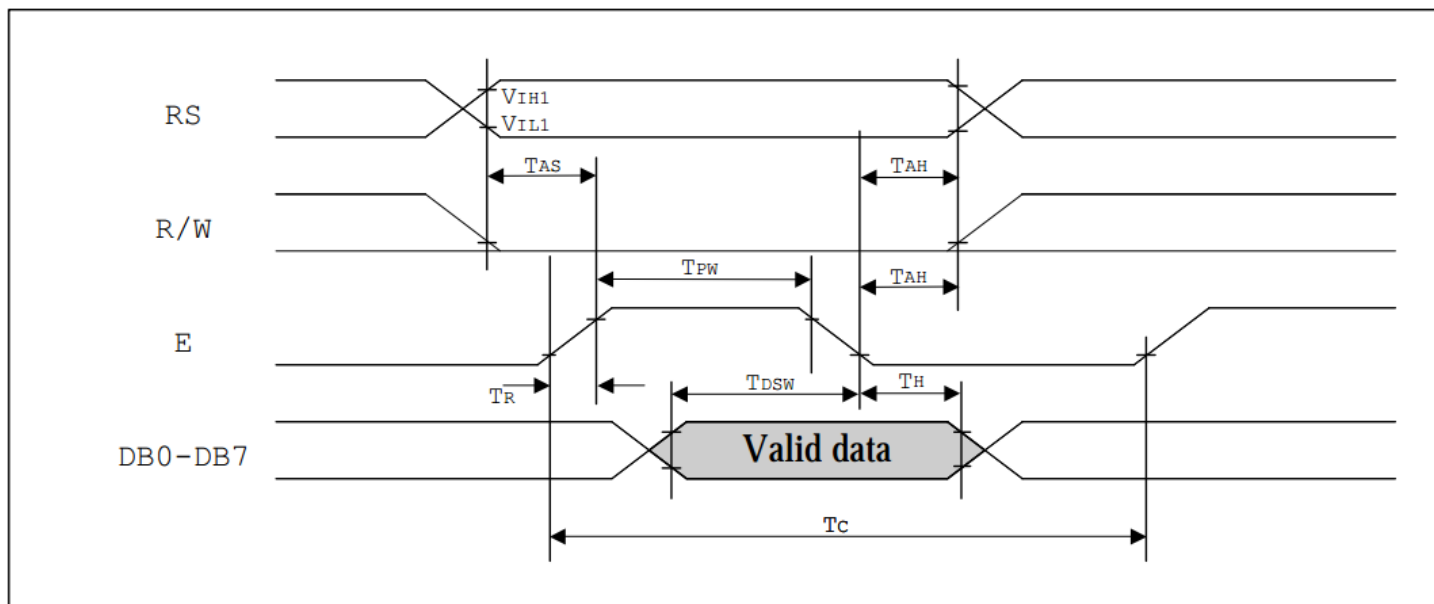
| Inst.                     | Code |    |     |          |     |     |     |         |     |     | Description                                                                                                                           | Exec time<br>(540KHZ) |
|---------------------------|------|----|-----|----------|-----|-----|-----|---------|-----|-----|---------------------------------------------------------------------------------------------------------------------------------------|-----------------------|
|                           | RS   | RW | DB7 | DB6      | DB5 | DB4 | DB3 | DB2     | DB1 | DB0 |                                                                                                                                       |                       |
| Display Clear             | 0    | 0  | 0   | 0        | 0   | 0   | 0   | 0       | 0   | 1   | Fill DDRAM with "20H" and set DDRAM address counter (AC) to "00H".                                                                    | 1.6 ms                |
| Return Home               | 0    | 0  | 0   | 0        | 0   | 0   | 0   | 0       | 1   | X   | Set DDRAM address counter (AC) to "00H", and put cursor to origin : the content of DDRAM are not changed                              | 72 us                 |
| Entry Mode Set            | 0    | 0  | 0   | 0        | 0   | 0   | 0   | 1       | I/D | S   | Set cursor position and display shift when doing write or read operation                                                              | 72 us                 |
| Display Control           | 0    | 0  | 0   | 0        | 0   | 0   | 1   | D       | C   | B   | D=1: Display ON<br>C=1: Cursor ON<br>B=1: Character Blink ON                                                                          | 72 us                 |
| Cursor Display Control    | 0    | 0  | 0   | 0        | 0   | 1   | S/C | R/L     | X   | X   | Cursor position and display shift control; the content of DDRAM are not changed                                                       | 72 us                 |
| Function Set              | 0    | 0  | 0   | 0        | 1   | DL  | X   | 0<br>RE | X   | X   | DL=1 8-bit interface<br>DL=0 4-bit interface<br><b><u>RE=1: extended instruction</u></b><br><b><u>RE=0: basic instruction</u></b>     | 72 us                 |
| Set CGRAM Address.        | 0    | 0  | 0   | 1        | AC5 | AC4 | AC3 | AC2     | AC1 | AC0 | Set CGRAM address to address counter (AC)<br><b><u>Make sure that in extended instruction SR=0 (scroll or RAM address select)</u></b> | 72 us                 |
| Set DDRAM Address.        | 0    | 0  | 1   | 0<br>AC6 | AC5 | AC4 | AC3 | AC2     | AC1 | AC0 | Set DDRAM address to address counter (AC)<br>AC6 is fixed to 0                                                                        | 72 us                 |
| Read Busy Flag (BF) & AC. | 0    | 1  | BF  | AC6      | AC5 | AC4 | AC3 | AC2     | AC1 | AC0 | Read busy flag (BF) for completion of internal operation, also Read out the value of address counter (AC)                             | 0 us                  |
| Write RAM                 | 1    | 0  | D7  | D6       | D5  | D4  | D3  | D2      | D1  | D0  | Write data to internal RAM (DDRAM/CGRAM/GDRAM)                                                                                        | 72 us                 |
| Read RAM                  | 1    | 1  | D7  | D6       | D5  | D4  | D3  | D2      | D1  | D0  | Read data from internal RAM (DDRAM/CGRAM/GDRAM)                                                                                       | 72 us                 |

**Instruction set 2: (RE=1: extended instruction)**

| Inst.                                    | Code |    |     |        |          |          |            |            |            |            | Description                                                                                                                                                                                                            | Exec time<br>(540KHZ) |
|------------------------------------------|------|----|-----|--------|----------|----------|------------|------------|------------|------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------|
|                                          | RS   | RW | DB7 | DB6    | DB5      | DB4      | DB3        | DB2        | DB1        | DB0        |                                                                                                                                                                                                                        |                       |
| Standby                                  | 0    | 0  | 0   | 0      | 0        | 0        | 0          | 0          | 0          | 1          | Enter standby mode, any other instruction can terminate.<br>COM1...32 are halted.                                                                                                                                      | 72 us                 |
| Scroll or<br>RAM<br>Address.<br>Select   | 0    | 0  | 0   | 0      | 0        | 0        | 0          | 0          | 1          | SR         | SR=1: enable vertical scroll position<br>SR=0: enable CGRAM address ( <b>basic instruction</b> )                                                                                                                       | 72 us                 |
| Reverse<br>(by line)                     | 0    | 0  | 0   | 0      | 0        | 0        | 0          | 1          | R1         | R0         | Select 1 out of 4 line (in DDRAM) and decide whether to<br>reverse the display by toggling this instruction<br><b>R1,R0 initial value is 0,0</b>                                                                       | 72 us                 |
| Extended<br>Function<br>Set              | 0    | 0  | 0   | 0      | 1        | DL       | X          | 1<br>RE    | G          | 0          | DL=1 :8-bit interface<br>DL=0 :4-bit interface<br><b>RE=1: extended instruction set</b><br><b>RE=0: basic instruction set</b><br>G=1 :graphic display ON<br>G=0 :graphic display OFF                                   | 72 us                 |
| Set Scroll<br>Address                    | 0    | 0  | 0   | 1      | AC5      | AC4      | AC3        | AC2        | AC1        | AC0        | SR=1: AC5~AC0 the address of vertical scroll                                                                                                                                                                           | 72 us                 |
| Set Graphic<br>Display<br>RAM<br>Address | 0    | 0  | 1   | 0<br>0 | 0<br>AC5 | 0<br>AC4 | AC3<br>AC3 | AC2<br>AC2 | AC1<br>AC1 | AC0<br>AC0 | Set GDRAM address to address counter (AC)<br>Set the vertical address first and followed the horizontal<br>address by consecutive writings<br>Vertical address range: AC5...AC0<br>Horizontal address range: AC3...AC0 | 72 us                 |

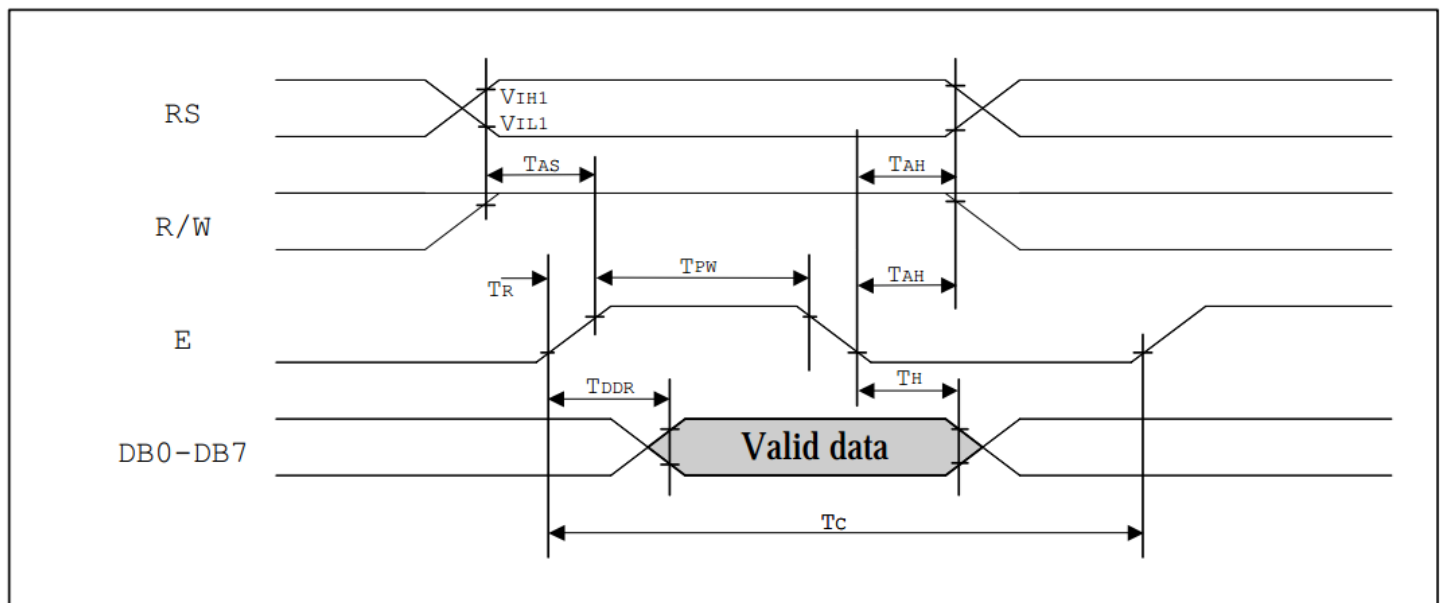
## Timing Characteristics

### MPU write data to ST7920



| Write Mode (Writing data from MPU to ST7920) |                       |                 |      |   |    |    |
|----------------------------------------------|-----------------------|-----------------|------|---|----|----|
| $T_C$                                        | Enable Cycle Time     | Pin E           | 1200 | - | -  | ns |
| $T_{PW}$                                     | Enable Pulse Width    | Pin E           | 140  | - | -  | ns |
| $T_R, T_F$                                   | Enable Rise/Fall Time | Pin E           | -    | - | 25 | ns |
| $T_{AS}$                                     | Address Setup Time    | Pins: RS,RW,E   | 10   | - | -  | ns |
| $T_{AH}$                                     | Address Hold Time     | Pins: RS,RW,E   | 20   | - | -  | ns |
| $T_{DSW}$                                    | Data Setup Time       | Pins: DB0 - DB7 | 40   | - | -  | ns |
| $T_H$                                        | Data Hold Time        | Pins: DB0 - DB7 | 20   | - | -  | ns |

## MPU read data from ST7920



| Read Mode (Reading Data from ST7920 to MPU) |                       |                 |      |   |     |    |
|---------------------------------------------|-----------------------|-----------------|------|---|-----|----|
| $T_C$                                       | Enable Cycle Time     | Pin E           | 1200 | - | -   | ns |
| $T_{PW}$                                    | Enable Pulse Width    | Pin E           | 140  | - | -   | ns |
| $T_R, T_F$                                  | Enable Rise/Fall Time | Pin E           | -    | - | 25  | ns |
| $T_{AS}$                                    | Address Setup Time    | Pins: RS, RW, E | 10   | - | -   | ns |
| $T_{AH}$                                    | Address Hold Time     | Pins: RS, RW, E | 20   | - | -   | ns |
| $T_{DDR}$                                   | Data Delay Time       | Pins: DB0 - DB7 | -    | - | 100 | ns |
| $T_H$                                       | Data Hold Time        | Pins: DB0 - DB7 | 20   | - | -   | ns |

## Built-in Font Table

Please see: [http://www.newhavendisplay.com/app\\_notes/ST7920-OC\\_font.pdf](http://www.newhavendisplay.com/app_notes/ST7920-OC_font.pdf)

### Example Initialization Program

```
//-----
#include <REG52.H>
#include "AL.h"
sbit ID = P3^0;
sbit RW = P3^7;
sbit E = P3^4;
//-----
void Init()
{
    Wcom(0x38);
    Wcom(0x0C);
    Wcom(0x06);
    Wcom(0x02);
    Wcom(0x01);
    delay(10);
    Row = 0x80;
    for(Counthi = 1; Counthi <=32; Counthi++)
    {
        Wcom(0x3E);
        Wcom(Row);
        Wcom(0x80);
        for(Count = 1; Count <=40; Count++)
        {
            Wdata(0x00);
        }
        Row++;
    }
}
//-----
void Wcom(char i)
{
    P1 = i;
    ID = 0; //Reset P3.0
    RW = 0; //Reset P3.7
    E = 1; //Set P3.4
    delay(1);
    E = 0; //Reset P3.4
}
//-----
void Wdata(char i)
{
    P1 = i;
    ID = 1; //Set P3.0
    RW = 0; //Reset P3.7
    E = 1; //Set P3.4
    delay(1);
    E = 0; //Reset P3.4
}
//-----
```

## 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 , 48hrs                                                              | 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<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)