

# NHD-14432WG-BTFH-V#T

## Graphic Liquid Crystal Display Module

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

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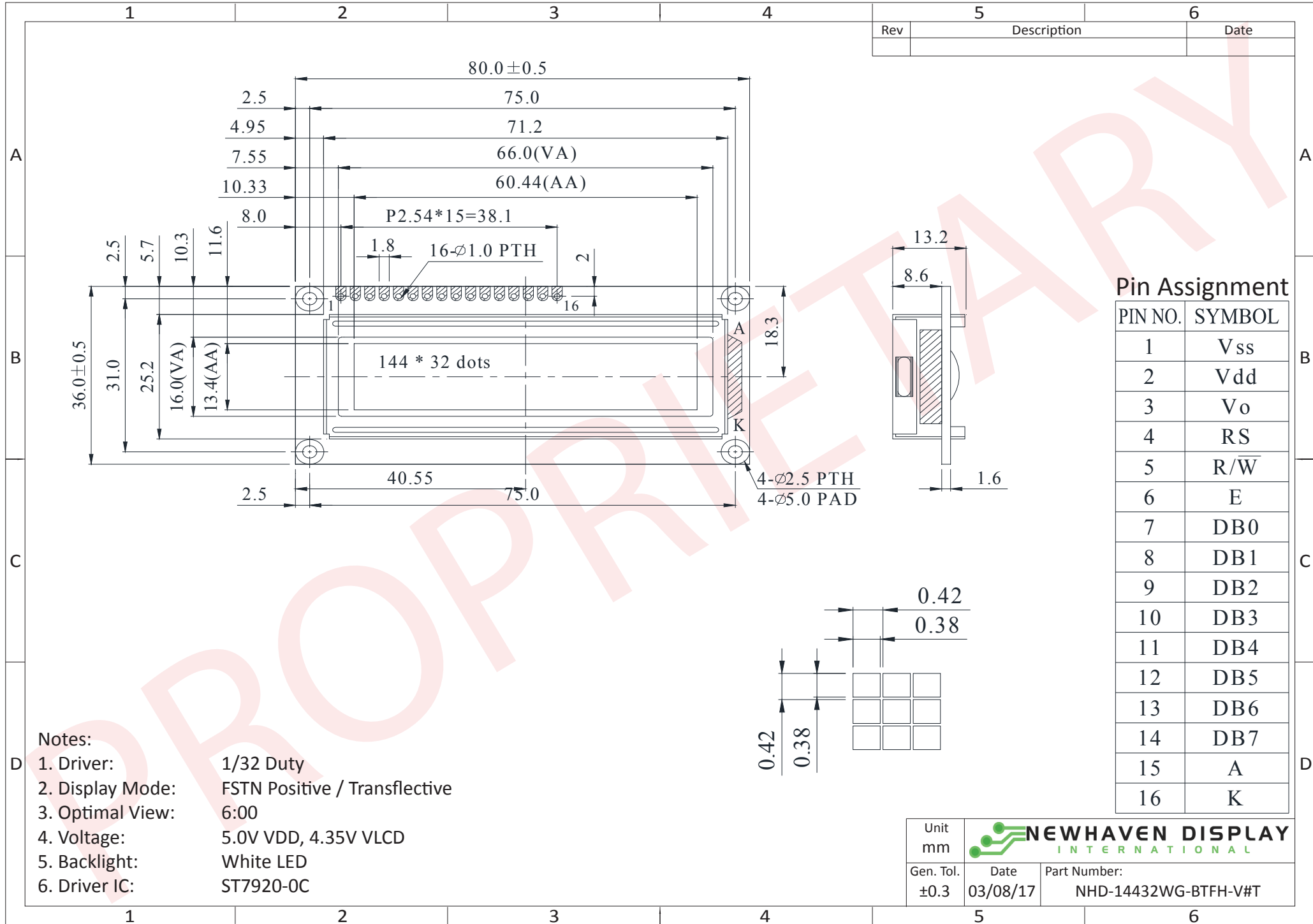
## Document Revision History

| Revision | Date     | Description                        | Changed by |
|----------|----------|------------------------------------|------------|
| 0        | 10/16/08 | Initial Release                    | -          |
| 1        | 4/5/10   | User guide reformat                | BE         |
| 2        | 5/10/10  | Block diagram/optical updated      | BE         |
| 3        | 5/14/10  | Updated Mechanical Drawing         | MC         |
| 4        | 1/24/12  | Timing characteristics updated     | AK         |
| 5        | 6/7/13   | Controller information added       | AK         |
| 6        | 11/4/16  | Electrical Characteristics Updated | TM         |
| 7        | 3/8/17   | Backlight Characteristics Updated  | SB         |
| 8        | 7/5/17   | Backlight Characteristics Updated  | TM         |
| 9        | 3/5/18   | Backlight Voltage Corrected        | SB         |

## Functions and Features

- 144x32 pixels
- Built-in ST7920-0C Controller
- +5.0V power supply
- 1/32 duty
- RoHS Compliant

# Mechanical Drawing



- Notes:
1. Driver: 1/32 Duty
  2. Display Mode: FSTN Positive / Transflective
  3. Optimal View: 6:00
  4. Voltage: 5.0V VDD, 4.35V VLCD
  5. Backlight: White LED
  6. Driver IC: ST7920-0C

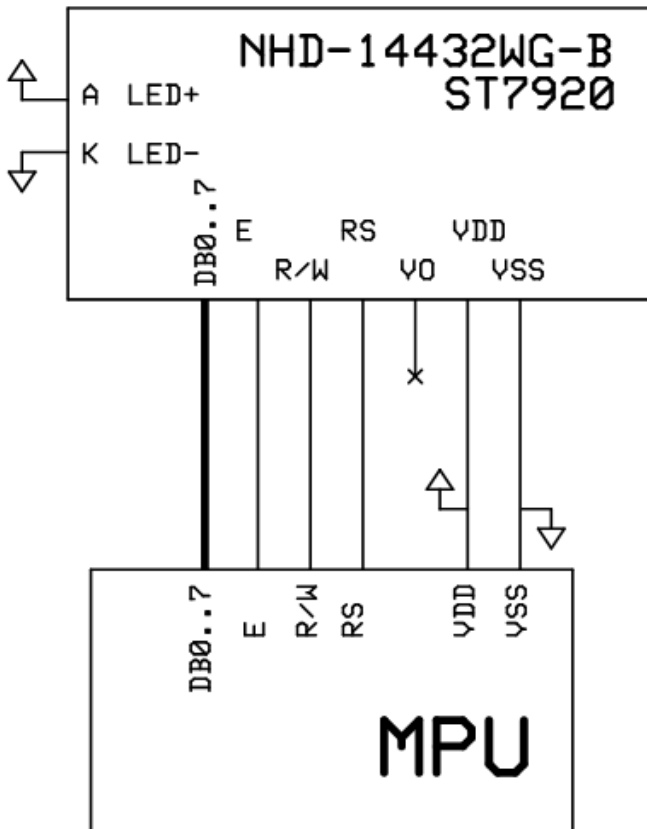
|                   |   |                                      |
|-------------------|---|--------------------------------------|
| Unit<br>mm        |  |                                      |
| Gen. Tol.<br>±0.3 | Date<br>03/08/17  | Part Number:<br>NHD-14432WG-BTFH-V#T |

## Pin Description and Wiring Diagram

| Pin No. | Symbol          | External Connection | Function Description                                 |
|---------|-----------------|---------------------|--|
| 1       | V <sub>SS</sub> | Power Supply        | Ground   |
| 2       | V <sub>DD</sub> | Power Supply        | Power supply for Logic (+5.0V)                       |
| 3       | V <sub>0</sub>  | -                   | No Connect   |
| 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                 | This is an 8-bit bi-directional data bus             |
| 15      | LED+            | Power Supply        | Backlight Anode (32 mA)                              |
| 16      | LED-            | Power Supply        | Backlight Cathode (Ground)                           |

**Recommended LCD connector:** 2.54mm pitch pins

**Backlight connector:** -      **Mates with:** -



## Electrical Characteristics

| Item                        | Symbol           | Condition               | Min.                  | Typ. | Max.            | Unit |
|-----------------------------|------------------|-------------------------|-----------------------|------|-----------------|------|
| Operating Temperature Range | T <sub>OP</sub>  | Absolute Max            | -20                   | -    | +70             | °C   |
| Storage Temperature Range   | T <sub>ST</sub>  | Absolute Max            | -30                   | -    | +80             | °C   |
| Supply Voltage              | V <sub>DD</sub>  | -                       | 4.5                   | 5.0  | 5.5             | V    |
| Supply Current              | I <sub>DD</sub>  | T <sub>OP</sub> = 25°   | 0.5                   | 1.0  | 3.5             | mA   |
| Supply for LCD (contrast)   | V <sub>LCD</sub> | V <sub>DD</sub> = 5.0V  | 4.1                   | 4.35 | 4.5             | V    |
| "H" Level input             | V <sub>IH</sub>  | -                       | 0.7 * V <sub>DD</sub> | -    | V <sub>DD</sub> | V    |
| "L" Level input             | V <sub>IL</sub>  | -                       | V <sub>SS</sub>       | -    | 0.6             | V    |
| "H" Level output            | V <sub>OH</sub>  | -                       | 0.8 * V <sub>DD</sub> | -    | V <sub>DD</sub> | V    |
| "L" Level output            | V <sub>OL</sub>  | -                       | V <sub>SS</sub>       | -    | 0.4             | V    |
| Backlight Supply Voltage    | V <sub>LED</sub> | -                       | 3.4                   | 3.5  | 3.6             | V    |
| Backlight Supply Current    | I <sub>LED</sub> | V <sub>LED</sub> = 3.5V | 10                    | 30   | 40              | mA   |

## Optical Characteristics

| Item                   | Symbol | Condition              | Min. | Typ. | Max. | Unit |
|------------------------|--------|------------------------|------|------|------|------|
| Optimal Viewing Angles | Top    | CR ≥ 2                 | -    | 30   | -    | °    |
|                        | Bottom |                        | -    | 60   | -    | °    |
|                        | Left   |                        | -    | 45   | -    | °    |
|                        | Right  |                        | -    | 45   | -    | °    |
| Contrast Ratio         | CR     | -                      | 2    | 5    | -    | -    |
| Response Time          | Rise   | T <sub>OP</sub> = 25°C | -    | 150  | 200  | ms   |
|                        | Fall   |                        | -    | 150  | 200  | 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)

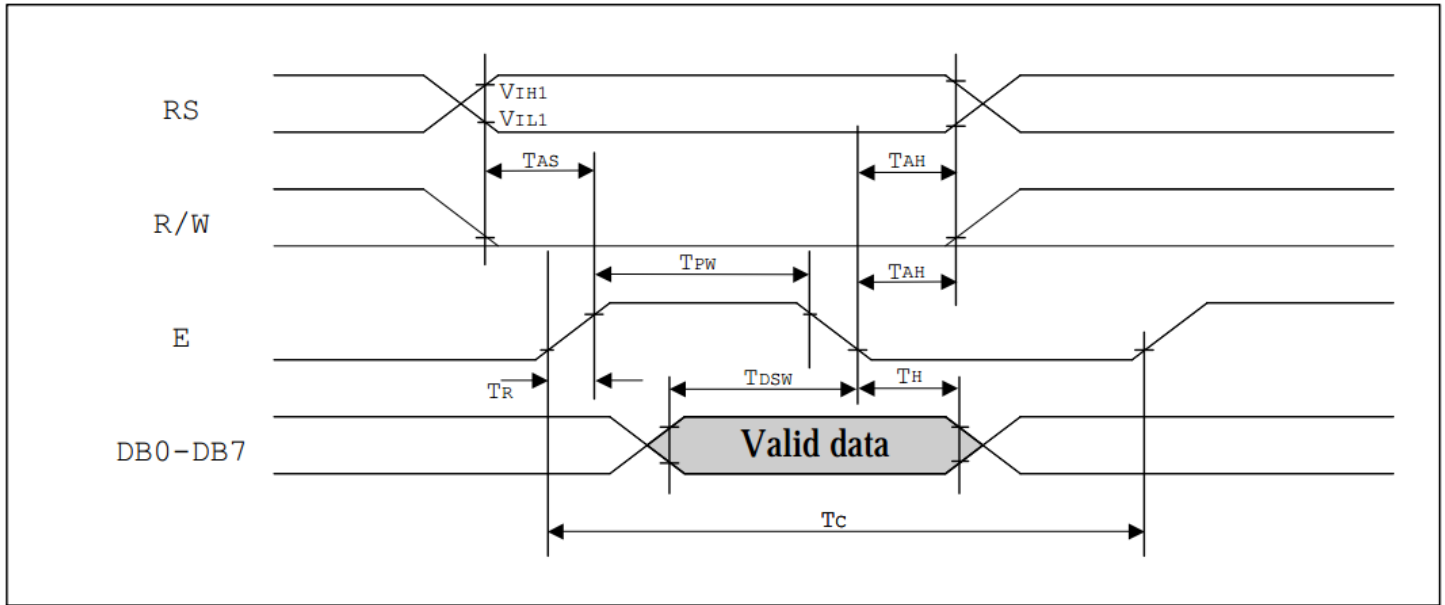
| Inst.                     | Code |    |     |          |     |     |     |         |     |     | Description  | Exec time (540KHZ) |
|---------------------------|------|----|-----|----------|-----|-----|-----|---------|-----|-----|--|--------------------|
|                           | RS   | RW | DB7 | 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>RE=1: extended instruction</b><br><b>RE=0: basic instruction</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>Make sure that in extended instruction SR=0 (scroll or RAM address select)</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   | 0   | 1        | SR<br>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   | 0   | 1   | R1<br>R0 | Select 1 out of 4 line (in DDRAM) and decide whether to 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   | 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   | 0   | 0   | AC3 | AC2 | AC1 | AC0      | Set GDRAM address to address counter (AC)<br>Set the vertical address first and followed the horizontal address by consecutive writings<br>Vertical address range: AC5...AC0<br>Horizontal address range: AC3...AC0 | 72 us  |       |

# Timing Characteristics

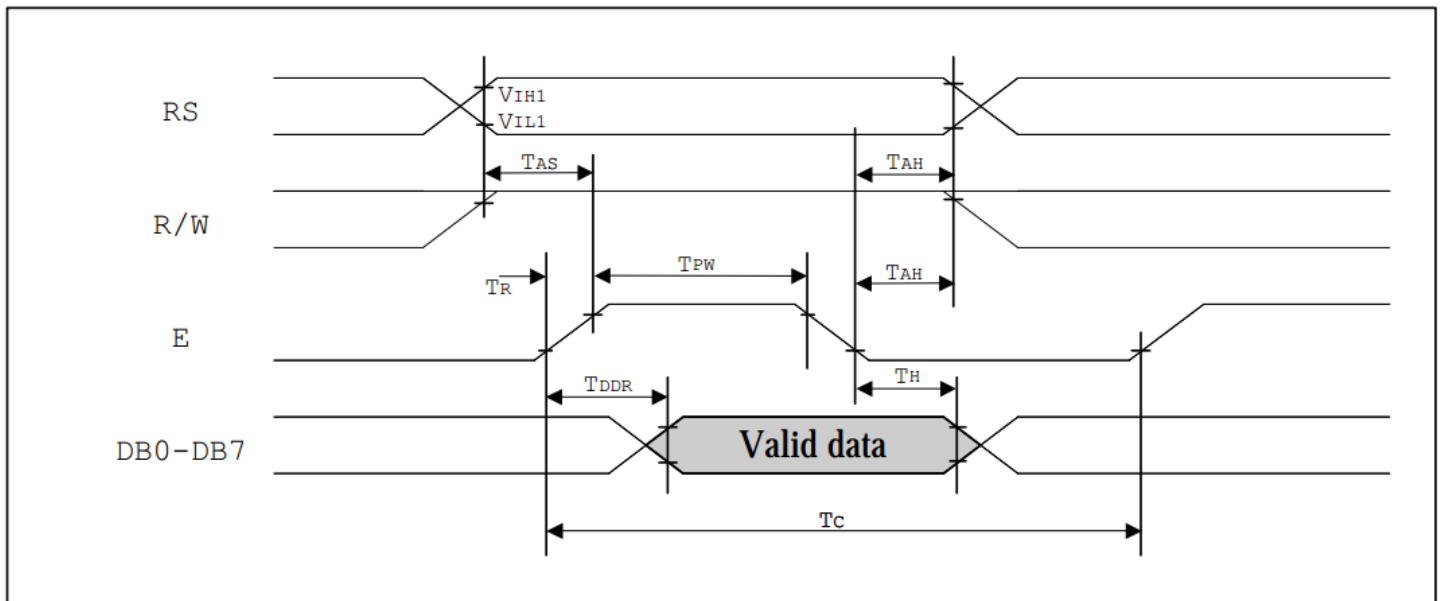
## MPU write data to ST7920



| 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)*

| <i>Read Mode (Reading Data from ST7920 to MPU)</i> |                       |                 |      |   |     |    |
|--|-----------------------|-----------------|------|---|-----|----|
| $T_C$  | 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/appnotes/fonttables/GraphLCD/ST7920-0C\\_font.pdf](http://www.newhavendisplay.com/appnotes/fonttables/GraphLCD/ST7920-0C_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 , 200 Hrs.  | 2    |
| Low Temperature storage               | Endurance test applying the low storage temperature for a long time.  | -30°C , 200 Hrs.  | 1,2  |
| High Temperature Operation            | Endurance test applying the electric stress (voltage & current) and the high thermal stress for a long time.                    | +70°C , 200 Hrs.  | 2    |
| Low Temperature Operation             | Endurance test applying the electric stress (voltage & current) and the low thermal stress for a long time.                     | -20°C , 200 Hrs.  | 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 , 96 Hrs.  | 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>For 10 cycles                |      |
| Vibration test                        | Endurance test applying vibration to simulate transportation and use.   | 10-55Hz, 1.5mm 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.  | V <sub>s</sub> =±800V, R <sub>s</sub> =330Ω, C <sub>s</sub> =150pF<br>10 Times      |      |

**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)