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Contact us

Tel: +86-755-8981 8866 Fax: +86-755-8427 6832

Email & Skype: info@chipsmall.com Web: www.chipsmall.com

Address: A1208, Overseas Decoration Building, #122 Zhenhua RD., Futian, Shenzhen, China



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 |
| | RoHS Compliant |

Newhaven Display International, Inc.

2661 Galvin Ct.

Elgin IL, 60124

Ph: 847-844-8795

Fax: 847-844-8796

www.newhavendisplay.com

nhtech@newhavendisplay.com

nhsales@newhavendisplay.com

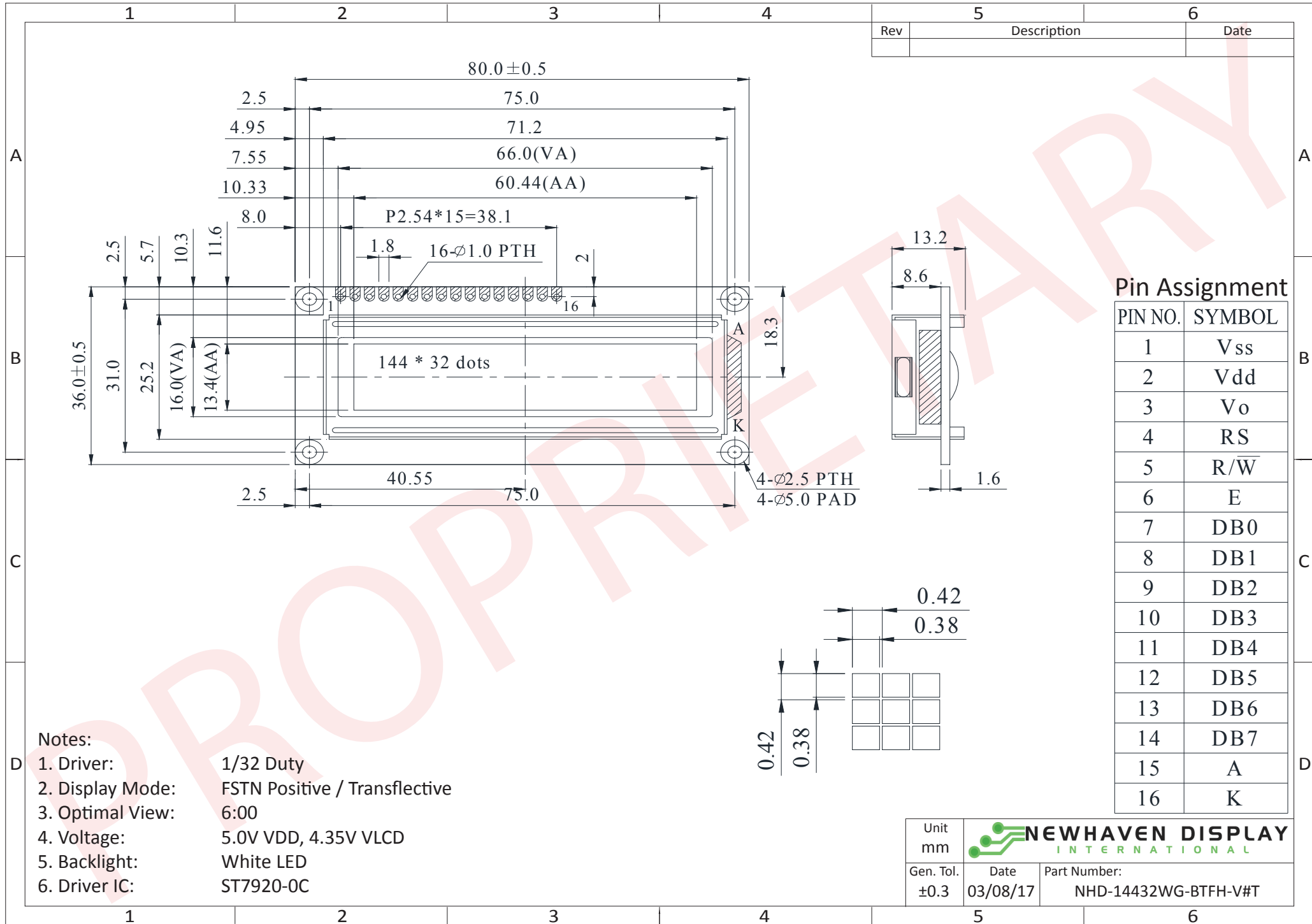
Document Revision History

| Revision | Date | Description | Changed by |
|----------|----------|------------------------------------|------------|
| 0 | 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 |

Functions and Features

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

Mechanical Drawing

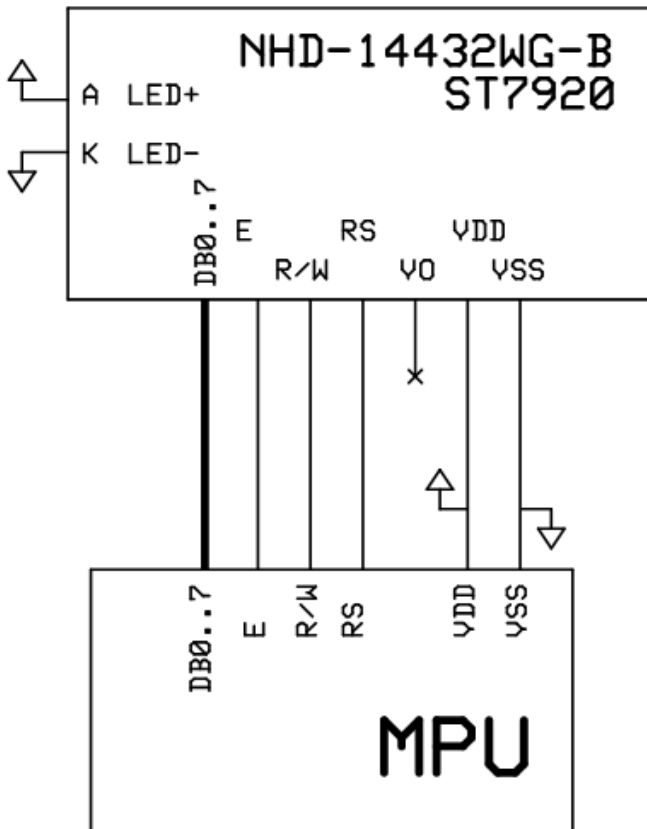


Pin Description and Wiring Diagram

| Pin No. | Symbol | External Connection | Function Description |
|---------|-----------------|---------------------|--|
| 1 | V _{SS} | Power Supply | Ground |
| 2 | V _{DD} | Power Supply | Power supply for Logic (+5.0V) |
| 3 | V ₀ | - | 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 _{OP} | Absolute Max | -20 | - | +70 | °C |
| Storage Temperature Range | T _{ST} | Absolute Max | -30 | - | +80 | °C |
| Supply Voltage | V _{DD} | - | 4.5 | 5.0 | 5.5 | V |
| Supply Current | I _{DD} | T _{OP} = 25° | 0.5 | 1.0 | 3.5 | mA |
| Supply for LCD (contrast) | V _{LCD} | V _{DD} = 5.0V | 4.1 | 4.35 | 4.5 | V |
| "H" Level input | V _{IH} | - | 0.7 * V _{DD} | - | V _{DD} | V |
| "L" Level input | V _{IL} | - | V _{SS} | - | 0.6 | V |
| "H" Level output | V _{OH} | - | 0.8 * V _{DD} | - | V _{DD} | V |
| "L" Level output | V _{OL} | - | V _{SS} | - | 0.4 | V |
| Backlight Supply Current | I _{LED} | - | - | 32 | 40 | mA |
| Backlight Supply Voltage | V _{LED} | I _{LED} = 32mA | 3.3 | 3.5 | 3.7 | V |

*The LED of the backlight is driven by current drain; drive voltage is for reference only. Drive voltage must be selected to ensure backlight current drain is below MAX level stated.

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 _{OP} = 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

Table of Commands

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

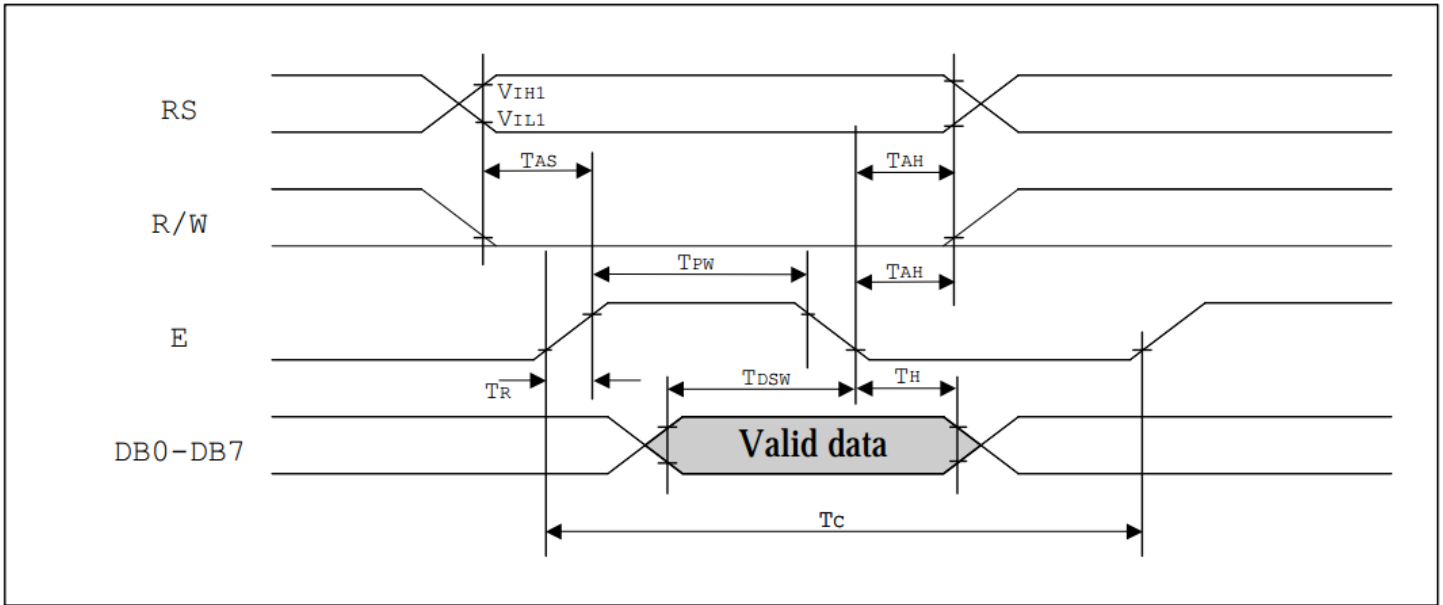
| Inst. | Code | | | | | | | | | | Description | Exec time (540KHZ) |
|---------------------------|------|----|-----|----------|-----|-----|-----|---------|-----|-----|--|--------------------|
| | RS | RW | DB7 | DB6 | DB5 | DB4 | DB3 | DB2 | DB1 | DB0 | | |
| Display Clear | 0 | 0 | 0 | 0 | 0 | 0 | 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 C=1: Cursor ON 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 RE | X | X | DL=1 8-bit interface DL=0 4-bit interface RE=1: extended instruction RE=0: basic instruction | 72 us |
| Set CGRAM Address. | 0 | 0 | 0 | 1 | AC5 | AC4 | AC3 | AC2 | AC1 | AC0 | Set CGRAM address to address counter (AC) Make sure that in extended instruction SR=0 (scroll or RAM address select) | 72 us |
| Set DDRAM Address. | 0 | 0 | 1 | 0 AC6 | AC5 | AC4 | AC3 | AC2 | AC1 | AC0 | Set DDRAM address to address counter (AC) 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 (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. COM1...32 are halted. | 72 us |
| Scroll or RAM Address. Select | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 SR | SR=1: enable vertical scroll position SR=0: enable CGRAM address (basic instruction) | 72 us |
| Reverse (by line) | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 R1 | R0 | Select 1 out of 4 line (in DDRAM) and decide whether to reverse the display by toggling this instruction R1,R0 initial value is 0,0 | 72 us |
| Extended Function Set | 0 | 0 | 0 | 0 | 1 | DL | X | 1 RE | G | 0 | DL=1 :8-bit interface DL=0 :4-bit interface RE=1: extended instruction set RE=0: basic instruction set G=1 :graphic display ON G=0 :graphic display OFF | 72 us |
| Set Scroll Address | 0 | 0 | 0 | 1 | AC5 | AC4 | AC3 | AC2 | AC1 | AC0 | SR=1: AC5~AC0 the address of vertical scroll | 72 us |
| Set Graphic Display RAM Address | 0 | 0 | 1 | 0 0 | 0 AC5 | 0 AC4 | AC3 AC3 | AC2 AC2 | AC1 AC1 | AC0 AC0 | Set GDRAM address to address counter (AC) Set the vertical address first and followed the horizontal address by consecutive writings Vertical address range: AC5...AC0 Horizontal address range: AC3...AC0 | 72 us |

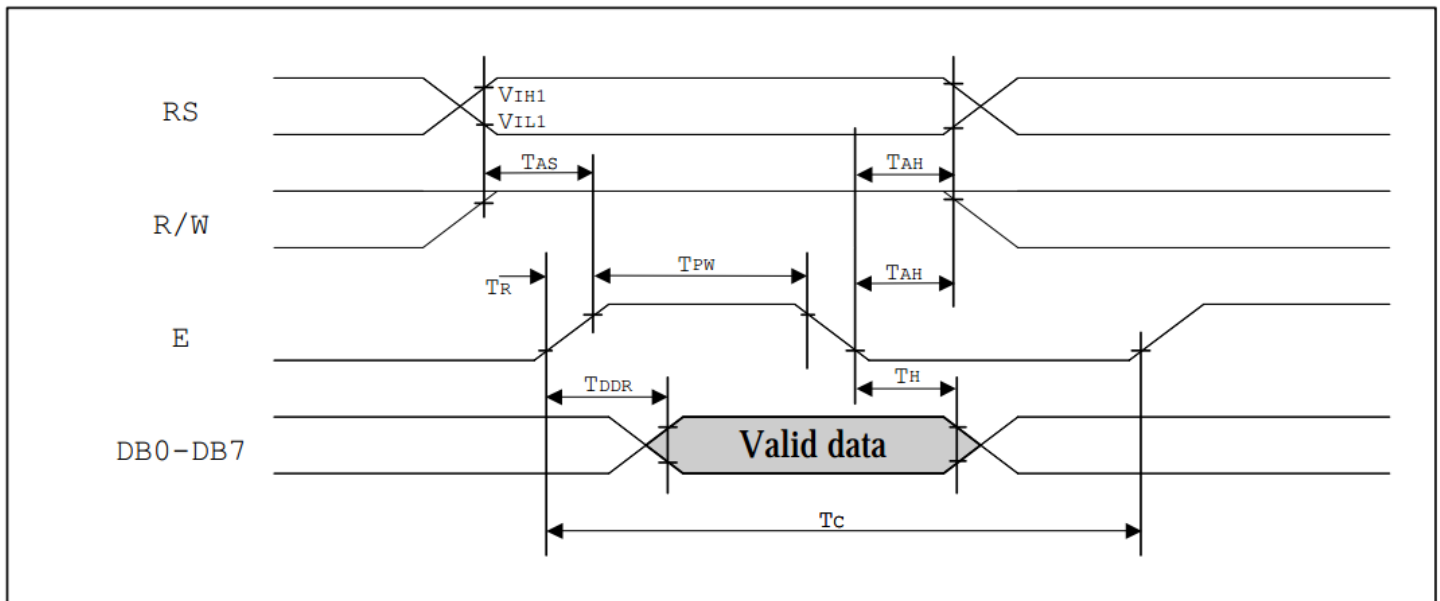
Timing Characteristics

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

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 For 10 cycles | |
| Vibration test | Endurance test applying vibration to simulate transportation and use. | 10-55Hz, 1.5mm amplitude. 60 sec in each of 3 directions X,Y,Z For 15 minutes | 3 |
| Static electricity test | Endurance test applying electric static discharge. | V _s =±800V, R _s =330Ω, C _s =150pF 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

Warranty Information and Terms & Conditions

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