

# 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

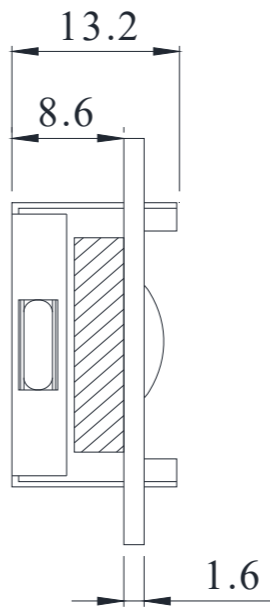
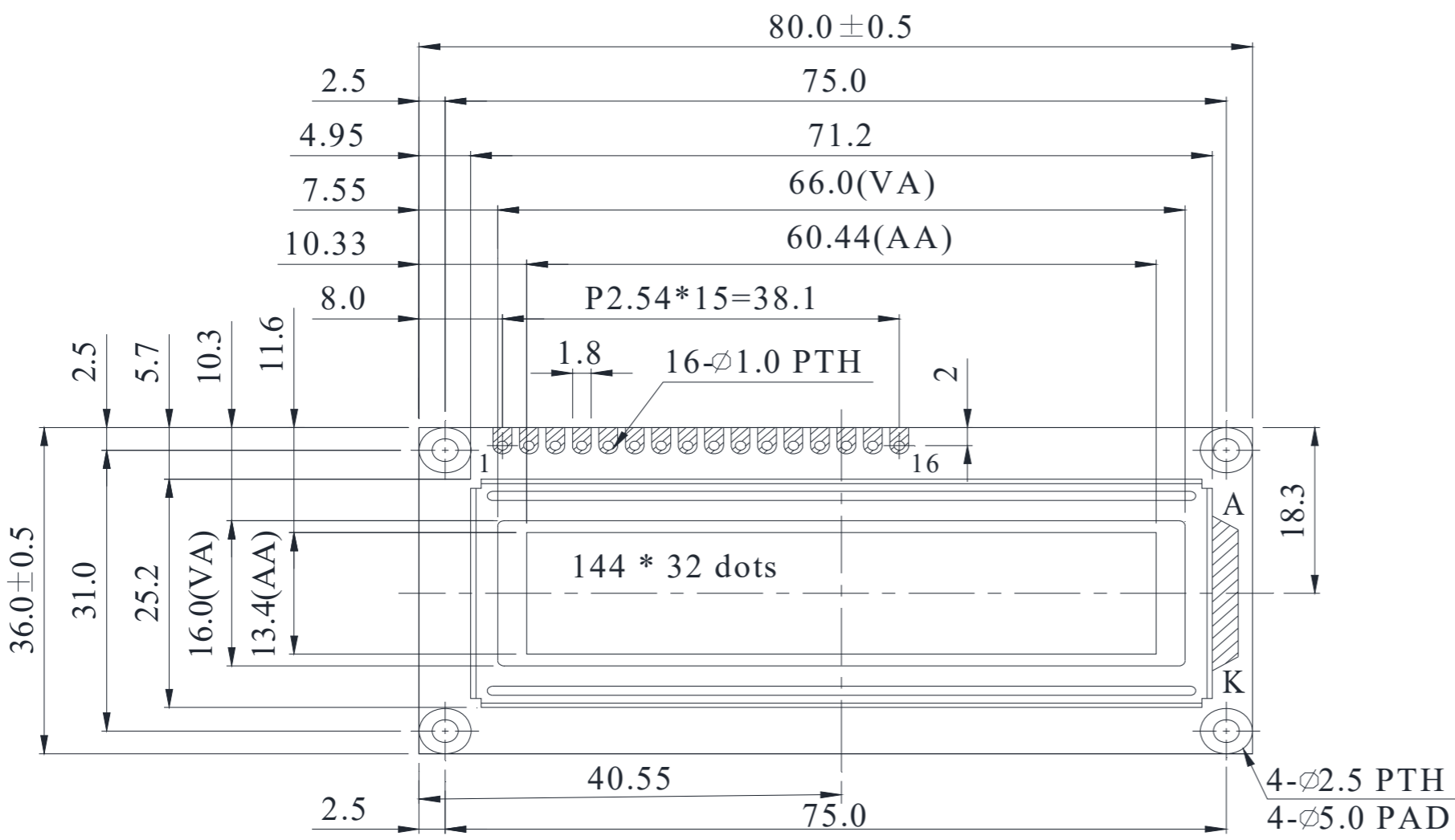
Revision	Date	Description	Changed by
0	10/16/08	Initial Release	-
1	4/5/10	User guide reformat	BE
2	5/10/10	Block diagram/optical updated	BE
3	5/14/10	Updated Mechanical Drawing	MC
4	1/24/12	Timing characteristics updated	AK
5	6/7/13	Controller information added	AK
6	11/4/16	Electrical Characteristics 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
10	5/5/20	Included Serial Interface Compatibility, Updated Wiring Diagram + Pinout	AS
11	9/30/20	Included Note on LCD Contrast Optimized for 25°C & Wiring Diagram	AS
12	3/23/21	Updated Notes in 2D Mechanical Drawing, Electrical Characteristics, & Quality Information	AS

## Functions and Features

- 144x32 pixels
- Built-in ST7920-0C Controller
- +5.0V power supply
- 1/32 duty
- Contrast Optimized for 25°C
- RoHS Compliant

# Mechanical Drawing

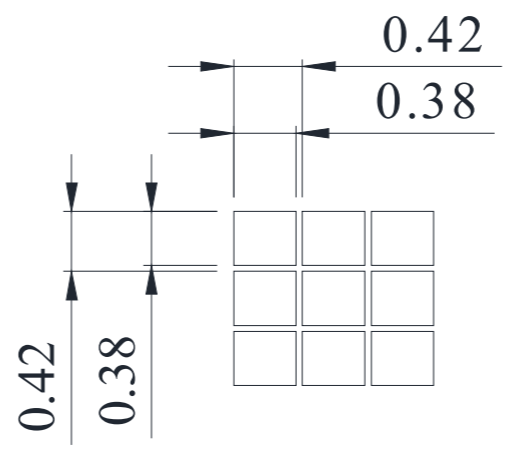
SYMBOL	REVISION	DATE



## Pin Assignment

PIN NO.	SYMBOL
1	V <sub>ss</sub>
2	V <sub>dd</sub>
3	V <sub>o</sub>
4	RS
5	R/W
6	E
7	DB0
8	DB1
9	DB2
10	DB3
11	DB4
12	DB5
13	DB6
14	DB7
15	A
16	K

- Notes:**
1. Driver: 1/32 Duty
  2. Display Mode: FSTN Positive / Transflective
  3. Optimal View: 6:00
  4. Voltage: 5.0V VDD
  5. Backlight: White LED
  6. Driver IC: ST7920-0C
  7. Contrast: Optimized Contrast @ 25°C



STANDARD TOLERANCE: (UNLESS OTHERWISE SPECIFIED)			
LINEAR: ±0.3mm		DRAWING/PART NUMBER: NHD-14432WG-BTFH-V#T	
UNLESS OTHERWISE SPECIFIED: - DIMENSIONS ARE IN MILLIMETERS - THIRD ANGLE PROJECTION		DRAWN BY: A. Shah	APPROVED BY: A. Shah
		DRAWN DATE: 3/23/21	APPROVED DATE: 3/23/21
		REVISION: 1.0	SIZE: A3
		SCALE: NS	SHEET 1 OF 1
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# Pin Description

## Parallel Interface: (Default)

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>	-	Do No Connect (Fixed Contrast Optimized for 25°C)
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 @ +3.5V)
16	LED-	Power Supply	Backlight Cathode (Ground)

## Serial Interface:

Pin No.	Symbol	External Connection	Function Description
1	V <sub>SS</sub>	Power Supply	Ground
2	V <sub>DD</sub>	Power Supply	Supply Voltage for LCD and logic (+5.0V)
3	V <sub>0</sub>	-	Do No Connect (Fixed Contrast Optimized for 25°C)
4	/CS	MPU	Active LOW Chip Select signal.
5	SID	MPU	Serial Data Input
6	SCLK	MPU	Serial Clock
7-14	NC	MPU	No Connect. Tie to Ground.
15	LED+	Power Supply	Backlight Anode (32mA @ +3.5V)
16	LED-	Power Supply	Backlight Cathode (Ground)

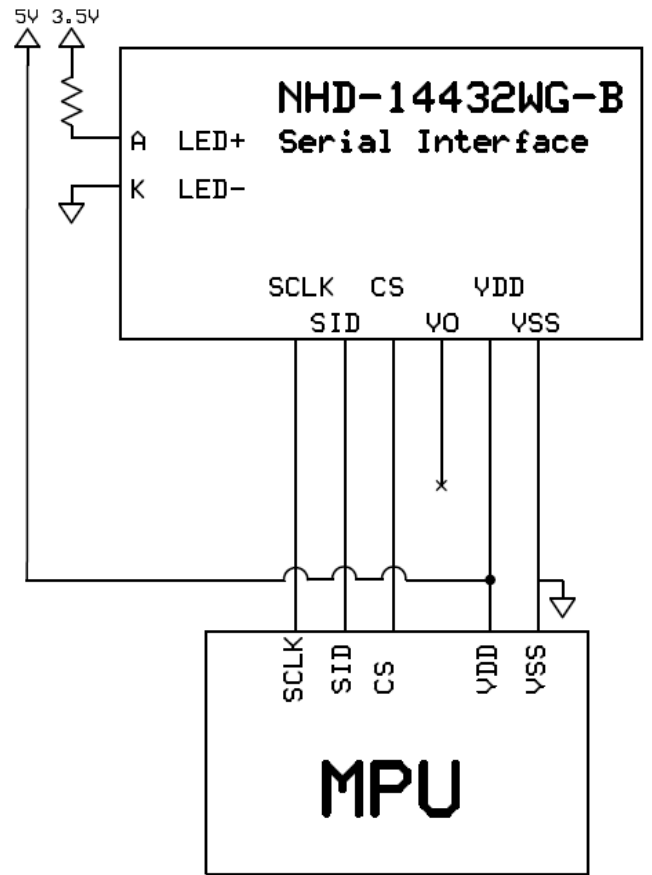
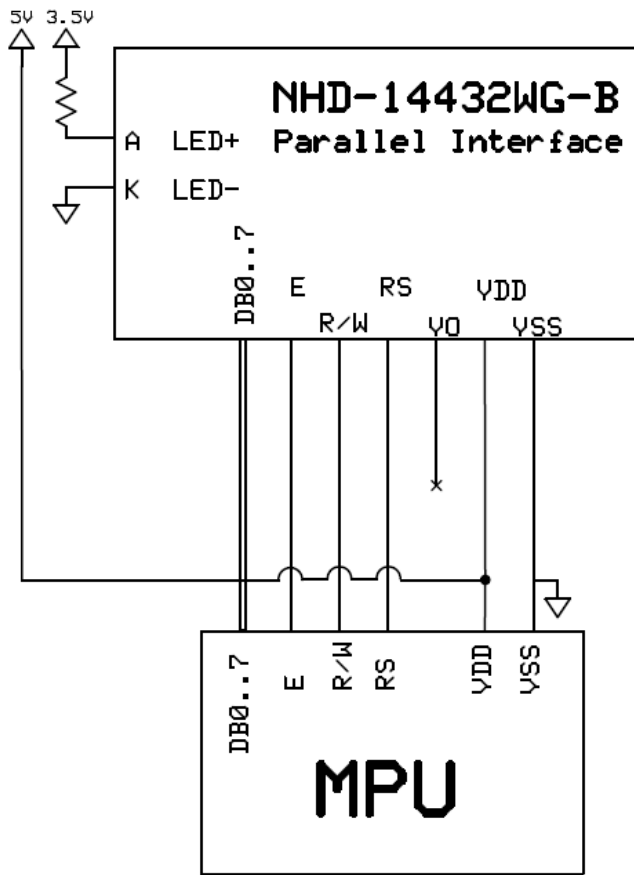
## MPU Interface Jumper Selection

MPU Interface	J3 (default)	J4
Parallel (default)	Short	Open
Serial	Open	Short

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

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

# Wiring Diagram



## 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>	V <sub>DD</sub> =5.0V	0.5	1.0	3.5	mA
Supply for LCD (Fixed Contrast)	V <sub>LCD</sub>	T <sub>OP</sub> =25° V <sub>DD</sub> =5.0V	-	-	-	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>	I <sub>LED</sub> = 32mA	3.4	3.5	3.6	V
Backlight Supply Current	I <sub>LED</sub>	-	10	32	40	mA

\*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 <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 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 <b>RE=1: extended instruction</b> <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) <b>Make sure that in extended instruction SR=0 (scroll or RAM address select)</b>	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

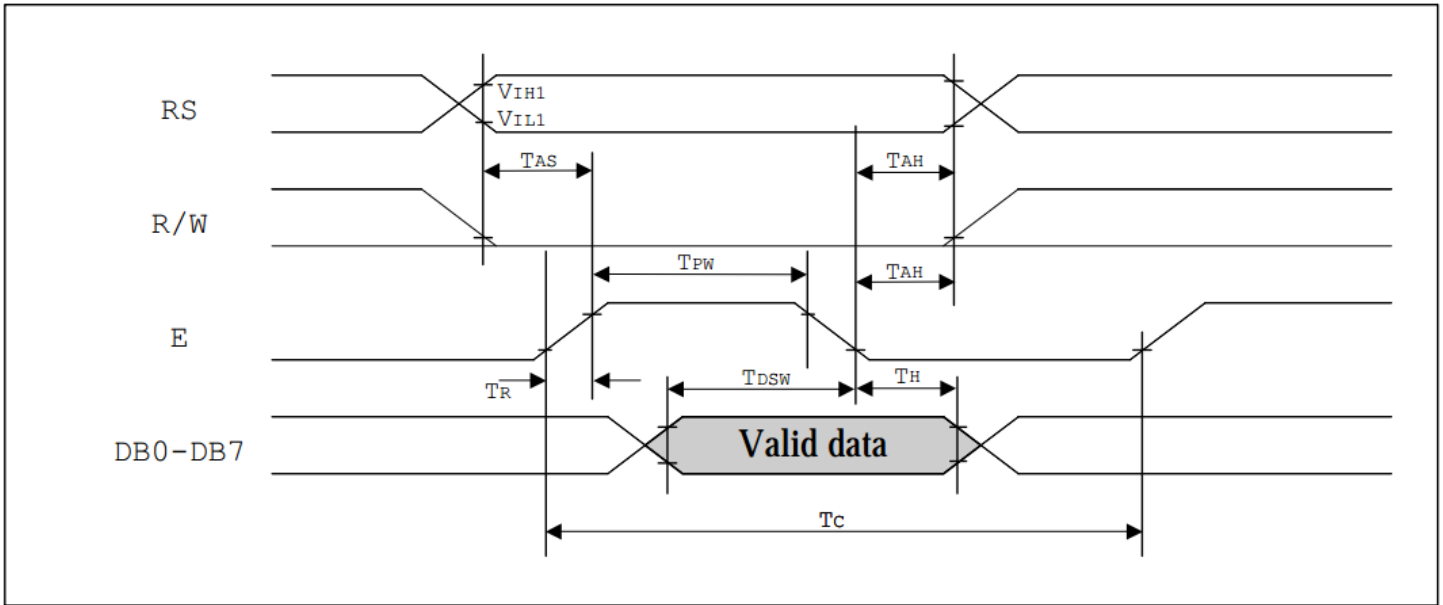
**Instruction set 2: (RE=1: extended instruction)**

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 ( <b>basic instruction</b> )	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 <b>R1,R0 initial value is 0,0</b>	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 <b>RE=1: extended instruction set</b> <b>RE=0: basic instruction set</b> 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	0 AC3	AC3 AC2	AC2 AC1	AC1 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



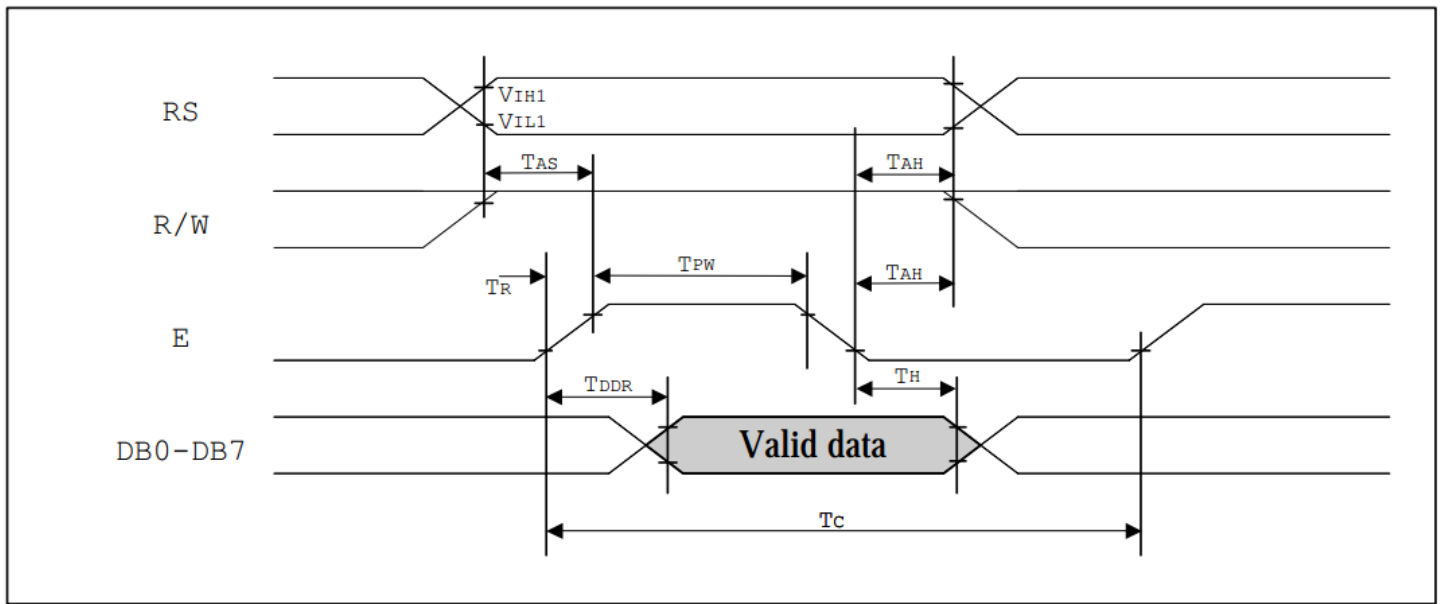
# Timing Characteristics

## 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)						
$T_C$	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 Storage	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.	Air: ±800V, R <sub>S</sub> =330Ω, C <sub>S</sub> =150pF Contact: ±600V, R <sub>S</sub> =330Ω, C <sub>S</sub> =150pF For 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)