

# NHD-16032AZ-FL-YBW

## Graphic Liquid Crystal Display Module

NHD-	Newhaven Display
16032-	160 x 32 pixels
AZ-	Model
F-	Transflective
L-	Yellow/Green LED backlight
Y-	STN- Yellow/Green
B-	6:00 View
W-	Wide Temperature (-20°C ~ +70°C)
	<b>RoHS Compliant</b>

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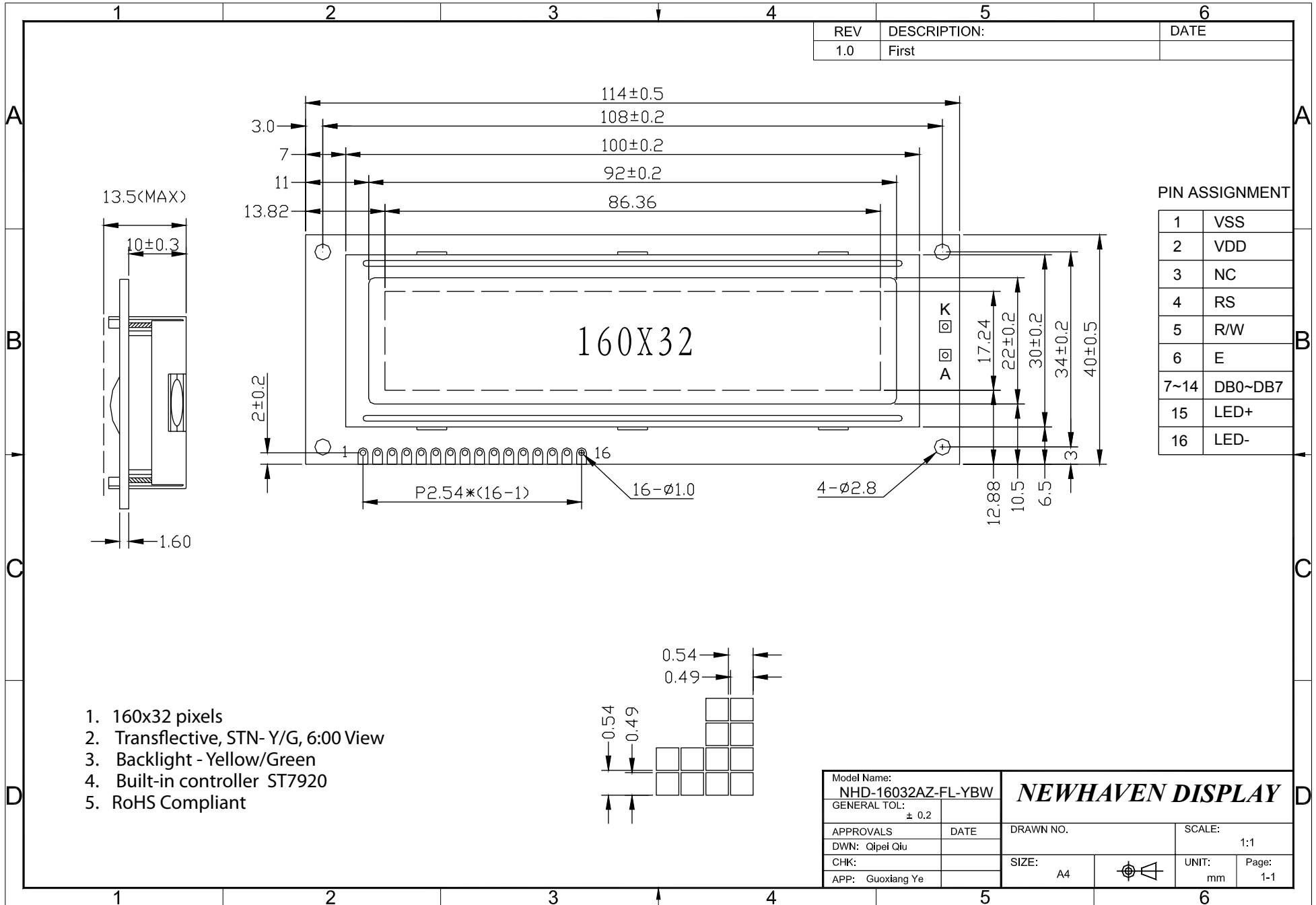
## Document Revision History

Revision	Date	Description	Changed by
0	2/28/2009	Initial Release	-
1	4/9/2010	User guide reformat	BE
2	5/7/2010	Block diagram/initialization update	BE

## Functions and Features

- 160x32 pixels
- Built-in ST7920 Controller
- +5.0V power supply
- 1/32 duty, 1/9 bias
- RoHS Compliant

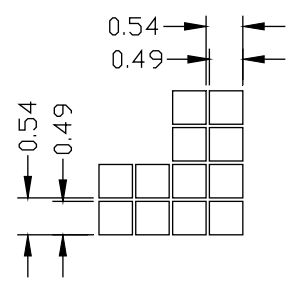
# Mechanical Drawing



REV	DESCRIPTION:	DATE
1.0	First	

1	VSS
2	VDD
3	NC
4	RS
5	R/W
6	E
7~14	DB0~DB7
15	LED+
16	LED-

1. 160x32 pixels
2. Transflective, STN- Y/G, 6:00 View
3. Backlight - Yellow/Green
4. Built-in controller ST7920
5. RoHS Compliant



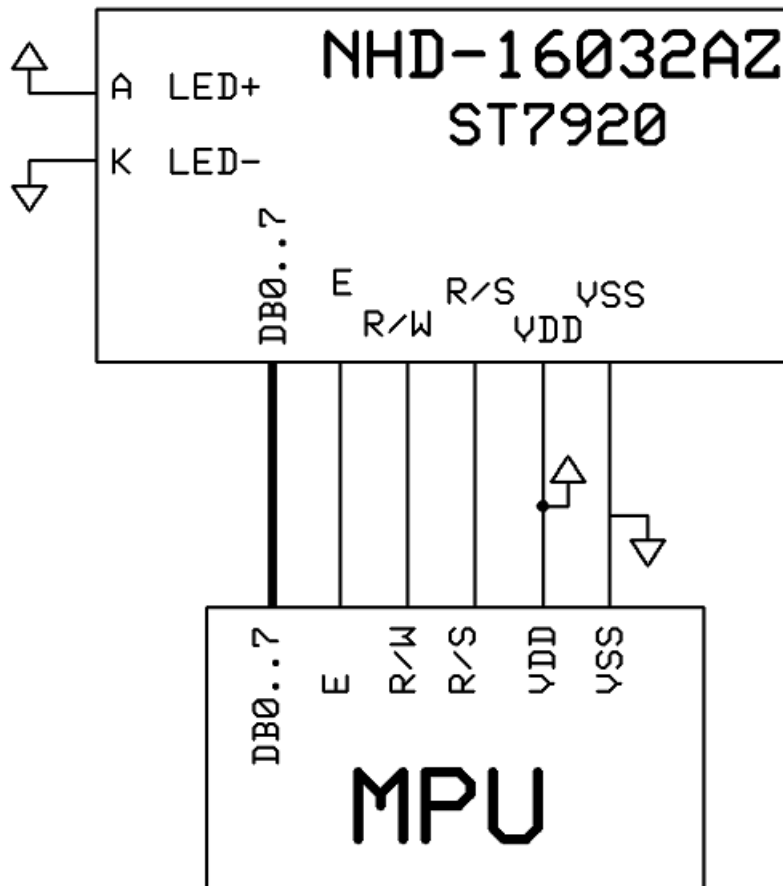
Model Name: <b>NHD-16032AZ-FL-YBW</b>		<b>NEWHAVEN DISPLAY</b>	
GENERAL TOL: ± 0.2			
APPROVALS	DATE	DRAWN NO.	SCALE: 1:1
CHK: Qipei Qiu		SIZE: A4	UNIT: mm
APP: Guoxiang Ye			Page: 1-1

## 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 (+5.0V)
3	NC	-	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	Power Supply for LED backlight (+5.0V via on-board resistor)
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		-	5.0	-	V
Supply Current	IDD	Ta=25°, VDD=5.0V	-	2.0	3.0	mA
Supply for LCD (contrast)	VDD-V0	-	-	-	-	-
"H" Level input	Vih		2.2	-	VDD	V
"L" Level input	Vil		0	-	0.6	V
"H" Level output	Voh		2.4	-	-	V
"L" Level output	Vol		-	-	0.4	V
Backlight Supply Voltage	Vled		-	5.0	-	V
Backlight Supply Current	Iled	Vled=5.0V	-	120	-	mA

## Optical Characteristics

Item	Symbol	Condition	Min.	Typ.	Max.	Unit
Viewing Angle - Vertical (top)	AH	Cr ≥ 3	-	10	-	°
Viewing Angle- Vertical (bottom)	AH	Cr ≥ 3	-	60	-	°
Viewing Angle- Horizontal (left)	AV	Cr ≥ 3	-	45	-	°
Viewing Angle - Horizontal (right)	AV	Cr ≥ 3	-	45	-	°
Contrast Ratio	Cr			5		
Response Time (rise)	Tr			100	150	ms
Response Time (fall)	Tf			150	200	ms

## Controller Information

Built-in ST7920. 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)

Ins	code										Description	Exec time (540KHZ)
	RS	RW	DB7	DB6	DB5	DB4	DB3	DB2	DB1	DB0		
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
HOME	0	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	72us
ENTRY MODE	0	0	0	0	0	0	0	0	1	I/D S	Set cursor position and display shift when doing write or read operation	72us
DISPLAY ON/OFF	0	0	0	0	0	0	0	1	D	C B	D=1: display ON C=1: cursor ON B=1: blink ON	72 us
CURSOR DISPLAY CONTROL	0	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	0	1	DL	X	0	RE X X	DL=1 8-BIT interface DL=0 4-BIT interface <b><u>RE=1: extended instruction</u></b> <b><u>RE=0: basic instruction</u></b>	72 us
SET CGRAM ADDR.	0	0	0	1	AC5	AC4	AC3	AC2	AC1	AC0	Set CGRAM address to address counter ( AC ) <b><u>Make sure that in extended instruction SR=0 (scroll or RAM address select)</u></b>	72 us
SET DDRAM ADDR.	0	0	1	0	AC5	AC4	AC3	AC2	AC1	AC0	Set DDRAM address to address counter ( AC ) AC6 is fixed to 0	72 us
READ BUSY FLAG (BF) & ADDR.	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/IRAM/GDRAM)	72 us
READ RAM	1	1	D7	D6	D5	D4	D3	D2	D1	D0	Read data from internal RAM (DDRAM/CGRAM/IRAM/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			
STAND BY	0	0	0	0	0	0	0	0	0	1	Enter stand by mode, any other instruction can terminate (Com1..32 halted, only Com33 ICON can display)	72 us	
SCROLL or RAM ADDR. SELECT	0	0	0	0	0	0	0	0	0	1	SR=1: enable vertical scroll position SR=0: enable IRAM address ( <b>extended instruction</b> ) SR=0: enable CGRAM address( <b>basic instruction</b> )	72 us	
REVERSE	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 00</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 IRAM or SCROLL ADDR	0	0	0	1	AC5	AC4	AC3	AC2	AC1	AC0	SR=1: AC5~AC0 the address of vertical scroll SR=0: AC3~AC0 the address of ICON RAM	72 us	
SET GRAPHIC RAM ADDR.	0	0	1	0	0	0	AC3	AC2	AC1	AC0	AC6 AC5 AC4 AC3 AC2 AC1 AC0	Set GDRAM address to address counter (AC) First set vertical address and the horizontal address by consecutive writing Vertical address range AC6...AC0 Horizontal address range AC3...AC0	72 us

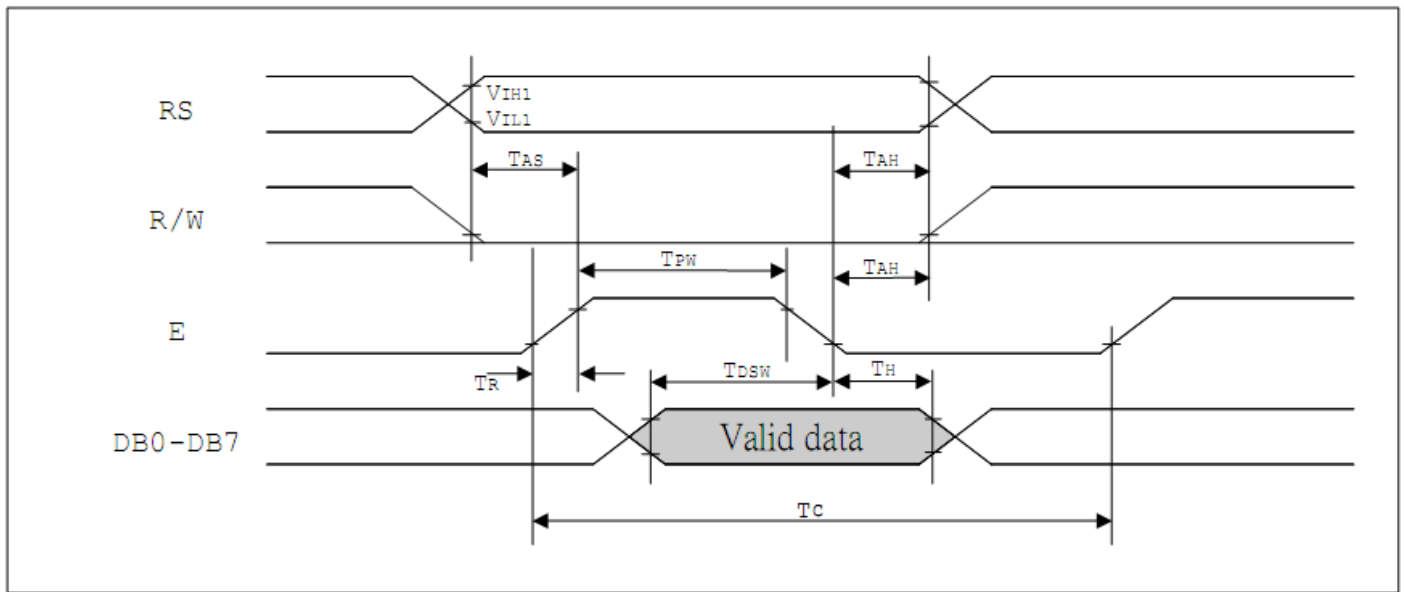
## Timing Characteristics

### DC Characteristics ( $T_A = 25^{\circ}\text{C}$ , $V_{DD} = 4.5\text{ V} - 5.5\text{ V}$ )

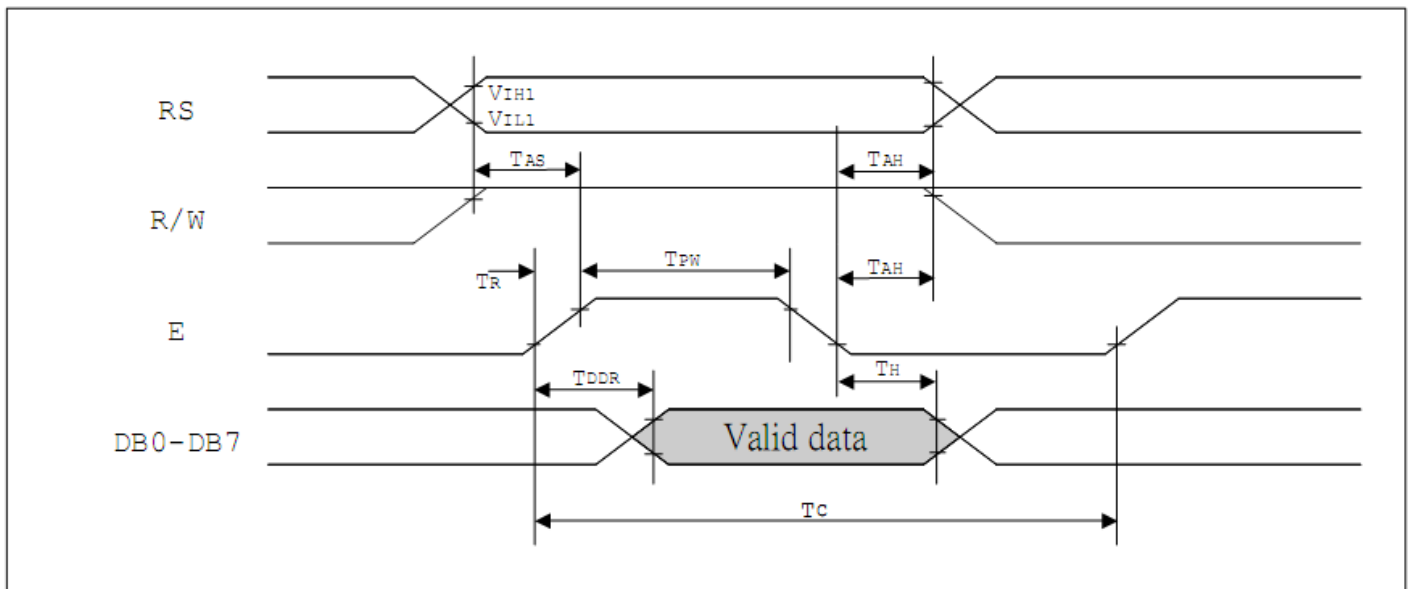
Symbol	Characteristics	Test Condition	Min.	Typ.	Max.	Unit
$V_{DD}$	Operating Voltage	-	4.5	-	5.5	V
$V_{LCD}$	LCD Voltage	$V_0 - V_{SS}$	3.0	-	7	V
$I_{CC}$	Power Supply Current	$f_{OSC} = 540\text{KHz}$ , $V_{DD} = 5\text{V}$ $R_f = 33\text{K}\Omega$	-	0.45	0.75	mA
$V_{IH1}$	Input High Voltage (Except OSC1)	-	$0.7V_{DD}$	-	$V_{DD}$	V
$V_{IL1}$	Input Low Voltage (Except OSC1)	-	-0.3	-	0.6	V
$V_{IH2}$	Input High Voltage (OSC1)	-	$V_{DD} - 1$	-	$V_{DD}$	V
$V_{IL2}$	Input Low Voltage (OSC1)	-	-	-	1.0	V
$V_{OH1}$	Output High Voltage (DB0 - DB7)	$I_{OH} = -0.1\text{mA}$	$0.8V_{DD}$	-	$V_{DD}$	V
$V_{OL1}$	Output Low Voltage (DB0 - DB7)	$I_{OL} = 0.1\text{mA}$	-	-	0.4	V
$V_{OH2}$	Output High Voltage (Except DB0 - DB7)	$I_{OH} = -0.04\text{mA}$	$0.8V_{DD}$	-	$V_{DD}$	V
$V_{OL2}$	Output Low Voltage (Except DB0 - DB7)	$I_{OL} = 0.04\text{mA}$	-	-	$0.1V_{DD}$	V
$I_{LEAK}$	Input Leakage Current	$V_{IN} = 0\text{V to } V_{DD}$	-1	-	1	$\mu\text{A}$
$I_{PUP}$	Pull Up MOS Current	$V_{DD} = 5\text{V}$	75	80	85	$\mu\text{A}$



## MPU write data to ST7920



## MPU read data from ST7920



## 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;  
    RW = 0;  
    E = 1;  
    delay(1);  
    E = 0;  
}  
  
void Wdata(char i)  
{  
    P1 = i;  
    ID = 1;  
    RW = 0;  
    E = 1;  
    delay(1);  
    E = 0;  
}
```

## 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 10 cycles	
Vibration test	Endurance test applying vibration to simulate transportation and use.	10-55Hz , 15mm amplitude. 60 sec in each of 3 directions X,Y,Z For 15 minutes	3
Static electricity test	Endurance test applying electric static discharge.	VS=800V, RS=1.5kΩ, CS=100pF 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)