

# NHD-0208AZ-RN-YBW-33V

## Character Liquid Crystal Display Module

|       |                        |
|-------|------------------------|
| NHD-  | Newhaven Display       |
| 0208- | 2 Lines x 8 Characters |
| AZ-   | Model                  |
| R-    | Reflective             |
| N-    | No Backlight           |
| Y-    | STN- Yellow/Green      |
| B-    | 6:00 Optimal View      |
| W-    | Wide Temperature       |
| 33V-  | 3.3V LCD               |
|       | <b>RoHS Compliant</b>  |

### Newhaven Display International, Inc.

2661 Galvin Ct.

Elgin IL, 60124

Ph: 847-844-8795

Fax: 847-844-8796

[www.newhavendisplay.com](http://www.newhavendisplay.com)

[nhtech@newhavendisplay.com](mailto:nhtech@newhavendisplay.com)

[nhsales@newhavendisplay.com](mailto:nhsales@newhavendisplay.com)

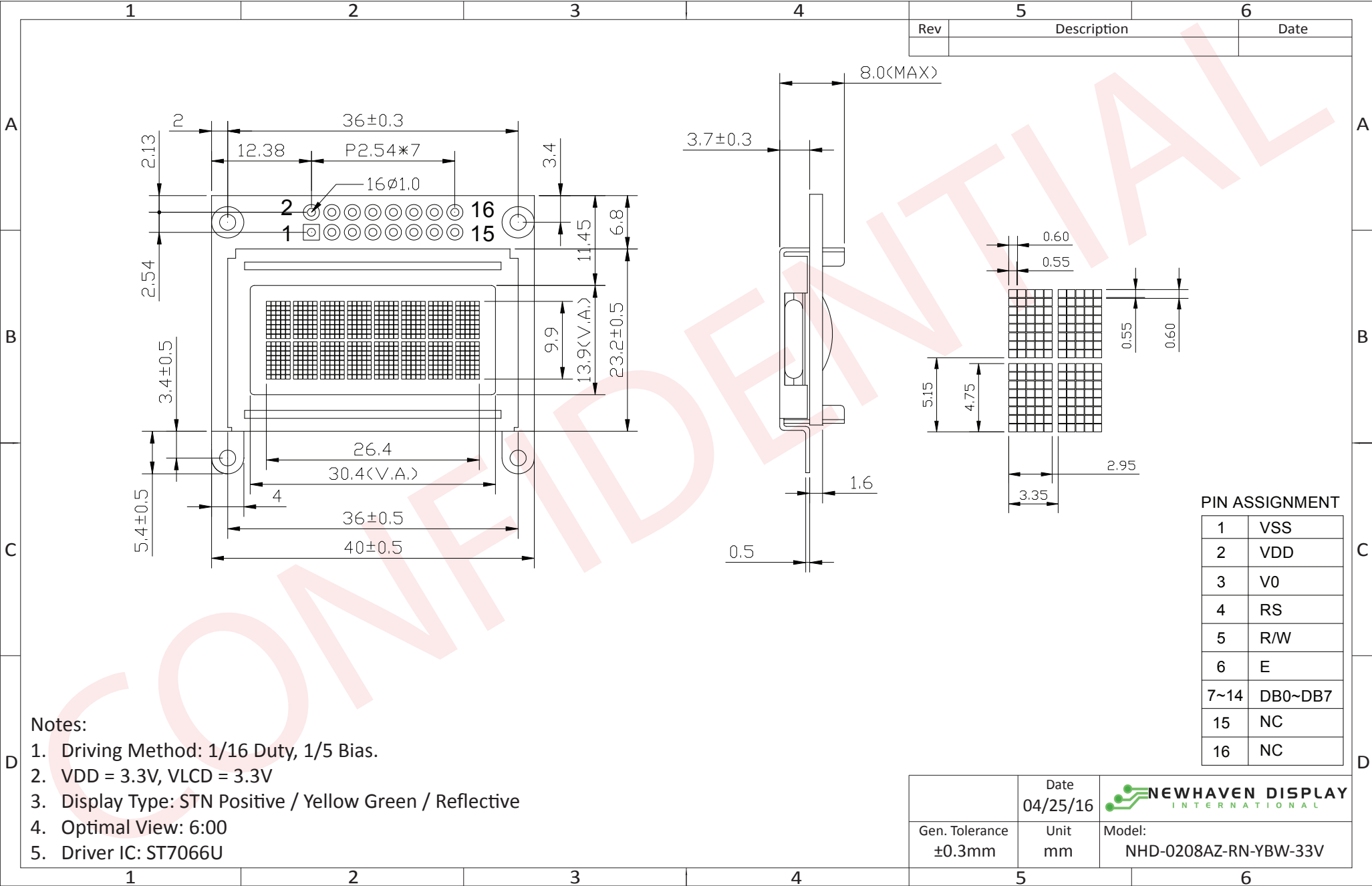
## Document Revision History

| Revision | Date       | Description                                                 | Changed by |
|----------|------------|-------------------------------------------------------------|------------|
| 0        | 10/31/2011 | 33V – improved liquid; VDD = 3.3V                           | SB         |
| 1        | 06/27/2013 | Mechanical and Timing characteristics updated               | KA         |
| 2        | 11/19/2013 | Mechanical Drawing updated                                  | ML         |
| 3        | 11/25/2013 | Mechanical drawing updated                                  | AK         |
| 4        | 4/24/2014  | Mechanical drawing updated                                  | ML         |
| 5        | 5/9/2014   | Electrical characteristics, Optical characteristics updated | ML         |
| 6        | 4/25/16    | Mechanical drawing updated                                  | SB         |

## Functions and Features

- 2 lines x 8 characters
- Built-in controller ST7066U
- +3.3V power supply
- 1/16 duty, 1/5 bias
- RoHS compliant

Mechanical Drawing



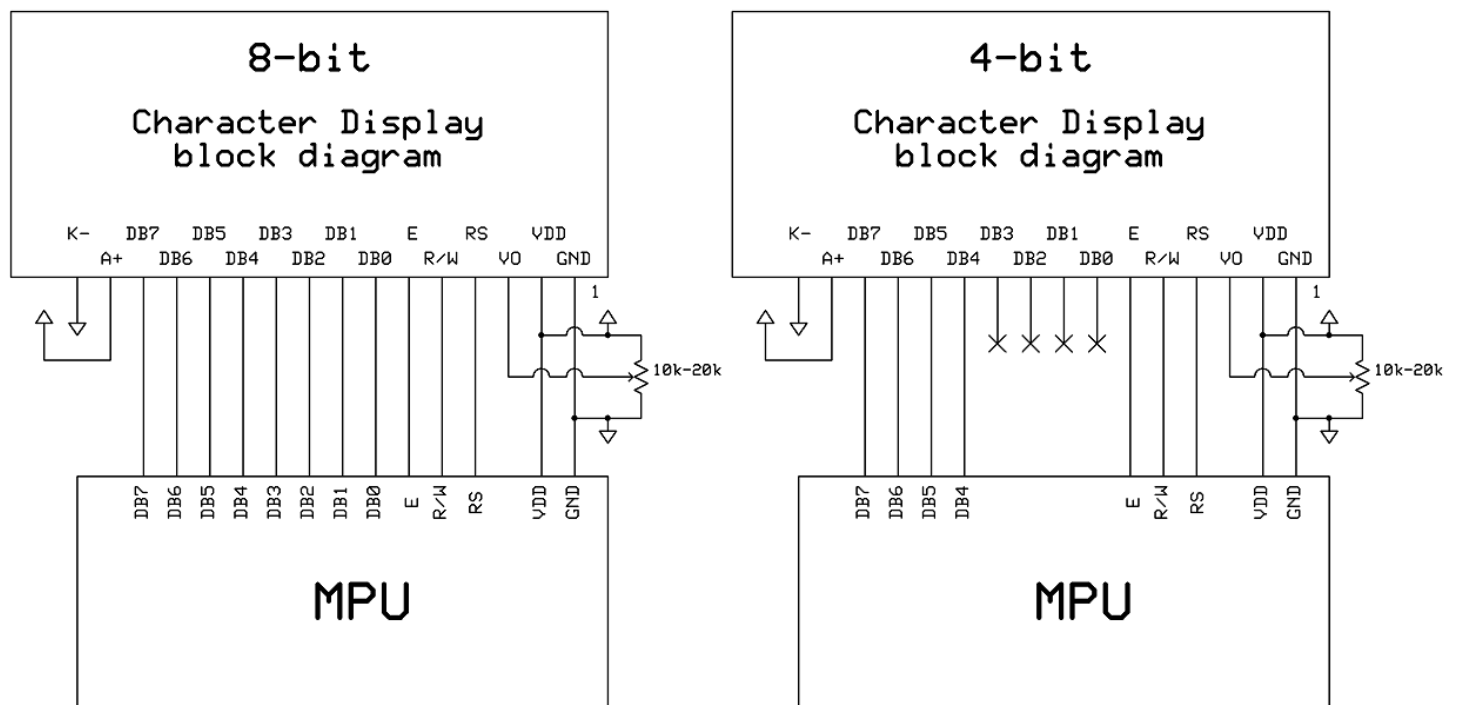
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## Pin Description and Wiring Diagram

| Pin No. | Symbol    | External Connection | Function Description                                                                                      |
|---------|-----------|---------------------|-----------------------------------------------------------------------------------------------------------|
| 1       | VSS       | Power Supply        | Ground                                                                                                    |
| 2       | VDD       | Power Supply        | Supply Voltage for logic (+3.3V)                                                                          |
| 3       | V0        | Adj Power Supply    | Power supply for contrast (approx. 0V)                                                                    |
| 4       | RS        | MPU                 | Register Select signal. RS=0: Command, RS=1: Data                                                         |
| 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.                                                          |
| 7-10    | DB0 – DB3 | MPU                 | Four low order bi-directional three-state data bus lines. These four are not used during 4-bit operation. |
| 11-14   | DB4 – DB7 | MPU                 | Four high order bi-directional three-state data bus lines.                                                |
| 15      | NC        | -                   | No Connect                                                                                                |
| 16      | NC        | -                   | No Connect                                                                                                |

**Recommended LCD connector:** 2x8 2.54mm pitch connector

**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    | -                   | 3.1      | 3.3  | 3.5     | V    |
| Supply Current              | IDD    | Ta=25°C<br>VDD=3.3V | -        | 1.5  | 2.5     | mA   |
| Supply for LCD (contrast)   | VDD-V0 |                     | 3.1      | 3.3  | 3.5     | V    |
| "H" Level input             | Vih    | -                   | 0.7*VDD  | -    | VDD     | V    |
| "L" Level input             | Vil    | -                   | -0.3     | -    | 0.6     | V    |
| "H" Level output            | Voh    | -                   | 0.75*VDD | -    | VDD     | V    |
| "L" Level output            | Vol    | -                   | GND      | -    | 0.2*VDD | V    |

## Optical Characteristics

| Item                   |        | Symbol      | Condition   | Min. | Typ. | Max. | Unit |
|------------------------|--------|-------------|-------------|------|------|------|------|
| Optimal Viewing Angles | Top    | $\phi Y+$   | $Cr \geq 2$ | -    | 40   | -    | °    |
|                        | Bottom | $\phi Y-$   |             | -    | 60   | -    | °    |
|                        | Left   | $\theta X-$ |             | -    | 60   | -    | °    |
|                        | Right  | $\theta X+$ |             | -    | 60   | -    | °    |
| Contrast Ratio         |        | Cr          | -           | 2    | 5    | -    | -    |
| Response Time          | Rise   | Tr          | -           | -    | 150  | 250  | ms   |
|                        | Fall   | Tf          | -           | -    | 200  | 300  | ms   |

## Controller Information

Built-in ST7066U controller.

Please download specification at [http://www.newhavendisplay.com/app\\_notes/ST7066U.pdf](http://www.newhavendisplay.com/app_notes/ST7066U.pdf)

## DDRAM Address

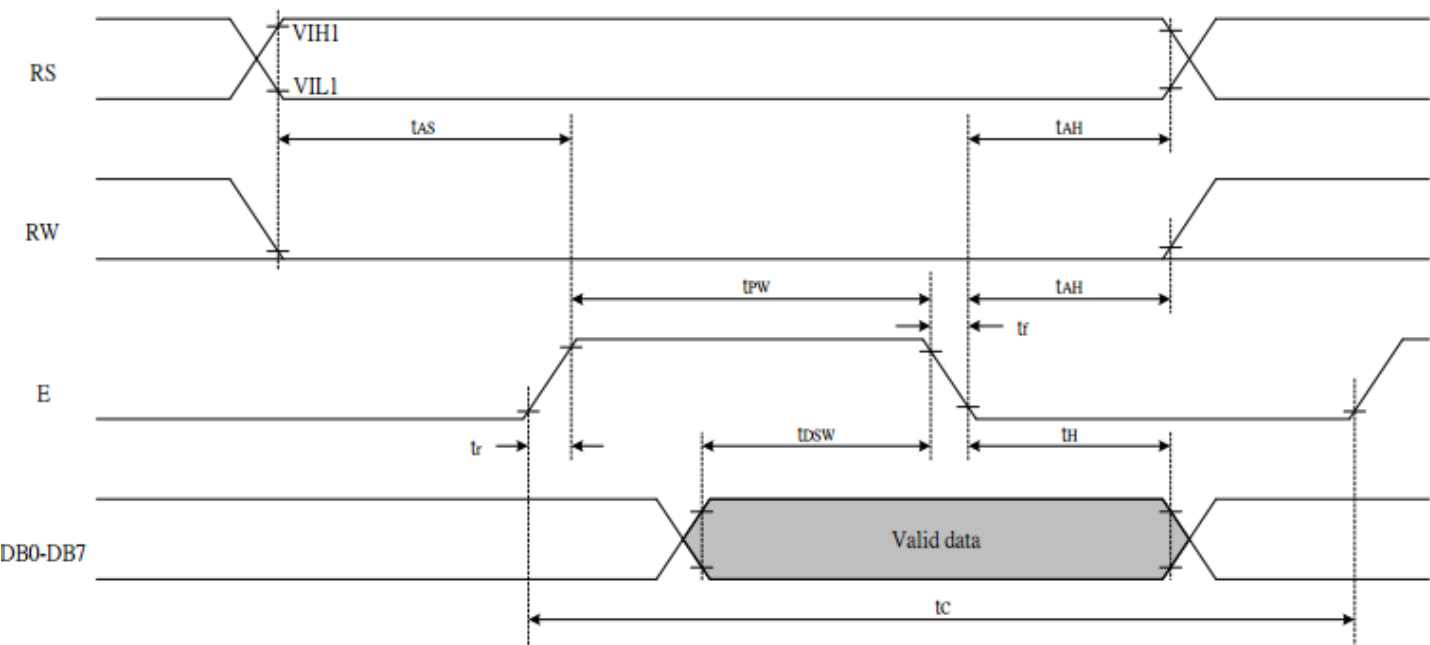
| 1  | 2  | 3  | 4  | 5  | 6  | 7  | 8  |
|----|----|----|----|----|----|----|----|
| 00 | 01 | 02 | 03 | 04 | 05 | 06 | 07 |
| 40 | 41 | 42 | 43 | 44 | 45 | 46 | 47 |

## Table of Commands

| Instruction                | Instruction code |     |     |     |     |     |     |     |     |     | Description                                                                                                                      | Execution time (fosc= 270 KHZ) |
|----------------------------|------------------|-----|-----|-----|-----|-----|-----|-----|-----|-----|----------------------------------------------------------------------------------------------------------------------------------|--------------------------------|
|                            | RS               | R/W | DB7 | DB6 | DB5 | DB4 | DB3 | DB2 | DB1 | DB0 |                                                                                                                                  |                                |
| Clear Display              | 0                | 0   | 0   | 0   | 0   | 0   | 0   | 0   | 0   | 1   | Write "20H" to DDRAM and set DDRAM address to "00H" from AC                                                                      | 1.52ms                         |
| Return Home                | 0                | 0   | 0   | 0   | 0   | 0   | 0   | 0   | 1   | -   | Set DDRAM Address to "00H" from AC and return cursor to its original position if shifted. The contents of DDRAM are not changed. | 1.52ms                         |
| Entry mode Set             | 0                | 0   | 0   | 0   | 0   | 0   | 0   | 1   | I/D | SH  | Sets cursor move direction and specifies display shift. These parameters are performed during data write and read.               | 37μs                           |
| Display ON/OFF control     | 0                | 0   | 0   | 0   | 0   | 0   | 1   | D   | C   | B   | D=1: Entire display on<br>C=1: Cursor on<br>B=1: Blinking cursor on                                                              | 37μs                           |
| Cursor or Display shift    | 0                | 0   | 0   | 0   | 0   | 1   | S/C | R/L | -   | -   | Sets cursor moving and display shift control bit, and the direction without changing DDRAM data.                                 | 37μs                           |
| Function set               | 0                | 0   | 0   | 0   | 1   | DL  | N   | F   | -   | -   | DL: Interface data is 8/4 bits<br>N: Number of lines is 2/1<br>F: Font size is 5x11/5x8                                          | 37μs                           |
| Set CGRAM Address          | 0                | 0   | 0   | 1   | AC5 | AC4 | AC3 | AC2 | AC1 | AC0 | Set CGRAM address in address counter                                                                                             | 37μs                           |
| Set DDRAM Address          | 0                | 0   | 1   | AC6 | AC5 | AC4 | AC3 | AC2 | AC1 | AC0 | Set DDRAM address in address counter.                                                                                            | 37μs                           |
| Read busy Flag and Address | 0                | 1   | BF  | AC6 | AC5 | AC4 | AC3 | AC2 | AC1 | AC0 | Whether during internal operation or not can be known by reading BF. The contents of address counter can also be read.           | 0s                             |
| Write data To Address      | 1                | 0   | D7  | D6  | D5  | D4  | D3  | D2  | D1  | D0  | Write data into internal RAM (DDRAM/CGRAM).                                                                                      | 37μs                           |
| Read data From RAM         | 1                | 1   | D7  | D6  | D5  | D4  | D3  | D2  | D1  | D0  | Read data from internal RAM (DDRAM/CGRAM).                                                                                       | 37μs                           |

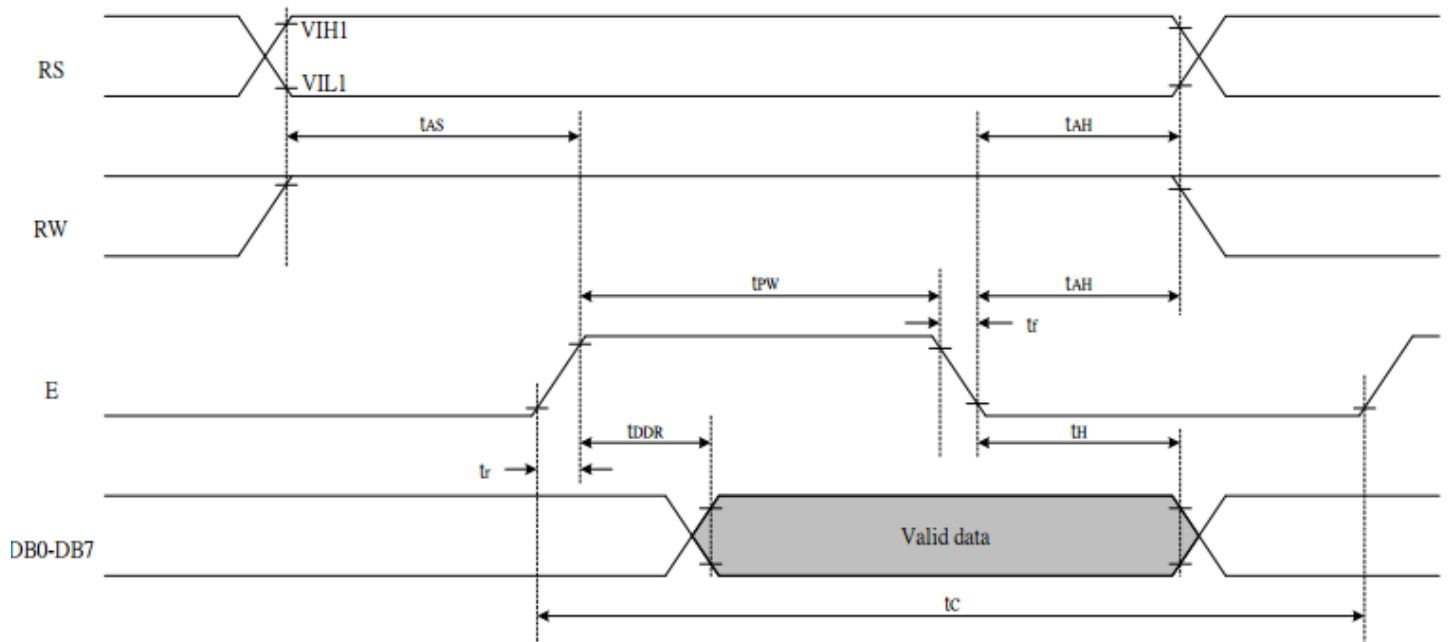
# Timing Characteristics

## Writing data from MPU to ST7066U



| Write Mode (Writing data from MPU to ST7066U) |                       |                 |      |   |    |    |
|-----------------------------------------------|-----------------------|-----------------|------|---|----|----|
| T <sub>C</sub>                                | Enable Cycle Time     | Pin E           | 1200 | - | -  | ns |
| T <sub>PW</sub>                               | Enable Pulse Width    | Pin E           | 460  | - | -  | ns |
| T <sub>R</sub> , T <sub>F</sub>               | Enable Rise/Fall Time | Pin E           | -    | - | 25 | ns |
| T <sub>AS</sub>                               | Address Setup Time    | Pins: RS, RW, E | 0    | - | -  | ns |
| T <sub>AH</sub>                               | Address Hold Time     | Pins: RS, RW, E | 10   | - | -  | ns |
| T <sub>DSW</sub>                              | Data Setup Time       | Pins: DB0 - DB7 | 80   | - | -  | ns |
| T <sub>H</sub>                                | Data Hold Time        | Pins: DB0 - DB7 | 10   | - | -  | ns |

## Reading data from ST7066U to MPU



| Read Mode (Reading Data from ST7066U to MPU) |                       |                 |      |   |     |    |
|----------------------------------------------|-----------------------|-----------------|------|---|-----|----|
| $T_C$                                        | Enable Cycle Time     | Pin E           | 1200 | - | -   | ns |
| $T_{PW}$                                     | Enable Pulse Width    | Pin E           | 480  | - | -   | ns |
| $T_R, T_F$                                   | Enable Rise/Fall Time | Pin E           | -    | - | 25  | ns |
| $T_{AS}$                                     | Address Setup Time    | Pins: RS,RW,E   | 0    | - | -   | ns |
| $T_{AH}$                                     | Address Hold Time     | Pins: RS,RW,E   | 10   | - | -   | ns |
| $T_{DDR}$                                    | Data Setup Time       | Pins: DB0 - DB7 | -    | - | 320 | ns |
| $T_H$                                        | Data Hold Time        | Pins: DB0 - DB7 | 10   | - | -   | ns |

## Built-in Font Table

| b7-b4<br>b3-b0 |                  | 0000 | 0001 | 0010 | 0011 | 0100 | 0101 | 0110 | 0111 | 1000 | 1001 | 1010 | 1011 | 1100 | 1101 | 1110 | 1111 |
|----------------|------------------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|
| 0000           | CG<br>RAM<br>(1) |      |      | 0    | 1    | 2    | 3    | 4    | 5    |      |      | 6    | 7    | 8    | 9    | A    | B    |
| 0001           | (2)              |      |      | C    | D    | E    | F    | G    | H    |      |      | I    | J    | K    | L    | M    | N    |
| 0010           | (3)              |      |      | O    | P    | Q    | R    | S    | T    |      |      | U    | V    | W    | X    | Y    | Z    |
| 0011           | (4)              |      |      | a    | b    | c    | d    | e    | f    |      |      | g    | h    | i    | j    | k    | l    |
| 0100           | (5)              |      |      | m    | n    | o    | p    | q    | r    |      |      | s    | t    | u    | v    | w    | x    |
| 0101           | (6)              |      |      | y    | z    | [    | \    | ]    | ^    |      |      | _    | `    | {    |      | }    | ~    |
| 0110           | (7)              |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |
| 0111           | (8)              |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |
| 1000           | (1)              |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |
| 1001           | (2)              |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |
| 1010           | (3)              |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |
| 1011           | (4)              |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |
| 1100           | (5)              |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |
| 1101           | (6)              |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |
| 1110           | (7)              |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |
| 1111           | (8)              |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |

## Example Initialization Program

8-bit Initialization:

```

/*****/
void command(char i)
{
    P1 = i;                //put data on output Port
    D_I =0;                //D/I=LOW : send instruction
    R_W =0;                //R/W=LOW : Write
    E = 1;
    Delay(1);              //enable pulse width >= 300ns
    E = 0;                 //Clock enable: falling edge
}
/*****/
void write(char i)
{
    P1 = i;                //put data on output Port
    D_I =1;                //D/I=HIGH : send data
    R_W =0;                //R/W=LOW : Write
    E = 1;
    Delay(1);              //enable pulse width >= 300ns
    E = 0;                 //Clock enable: falling edge
}
/*****/
void init()
{
    E = 0;
    Delay(100);            //Wait >40 msec after power is applied
    command(0x30);          //command 0x30 = Wake up
    Delay(30);              //must wait 5ms, busy flag not available
    command(0x30);          //command 0x30 = Wake up #2
    Delay(10);              //must wait 160us, busy flag not available
    command(0x30);          //command 0x30 = Wake up #3
    Delay(10);              //must wait 160us, busy flag not available
    command(0x38);          //Function set: 8-bit/2-line
    command(0x10);          //Set cursor
    command(0x0c);          //Display ON; Cursor ON
    command(0x06);          //Entry mode set
}
/*****/
```

```

4-bit Initialization:
/*****/
void command(char i)
{
    P1 = i;                //put data on output Port
    D_I = 0;               //D/I=LOW : send instruction
    R_W = 0;               //R/W=LOW : Write
    Nybble();              //Send lower 4 bits
    i = i<<4;              //Shift over by 4 bits
    P1 = i;                //put data on output Port
    Nybble();              //Send upper 4 bits
}
/*****/
void write(char i)
{
    P1 = i;                //put data on output Port
    D_I = 1;               //D/I=HIGH : send data
    R_W = 0;               //R/W=LOW : Write
    Nybble();              //Clock lower 4 bits
    i = i<<4;              //Shift over by 4 bits
    P1 = i;                //put data on output Port
    Nybble();              //Clock upper 4 bits
}
/*****/
void Nybble()
{
    E = 1;
    Delay(1);              //enable pulse width >= 300ns
    E = 0;                 //Clock enable: falling edge
}
/*****/
void init()
{
    P1 = 0;
    P3 = 0;
    Delay(100);            //Wait >40 msec after power is applied
    P1 = 0x30;             //put 0x30 on the output port
    Delay(30);             //must wait 5ms, busy flag not available
    Nybble();              //command 0x30 = Wake up
    Delay(10);             //must wait 160us, busy flag not available
    Nybble();              //command 0x30 = Wake up #2
    Delay(10);             //must wait 160us, busy flag not available
    Nybble();              //command 0x30 = Wake up #3
    Delay(10);             //can check busy flag now instead of delay
    P1= 0x20;              //put 0x20 on the output port
    Nybble();              //Function set: 4-bit interface
    command(0x28);         //Function set: 4-bit/2-line
    command(0x10);         //Set cursor
    command(0x0F);         //Display ON; Blinking cursor
    command(0x06);         //Entry Mode set
}
/*****/

```

## 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

See Terms and Conditions at [http://www.newhavendisplay.com/index.php?main\\_page=terms](http://www.newhavendisplay.com/index.php?main_page=terms)

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