

**Product Specification**

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# NHD-0208BZ-FSW-GBW-33V3

## Character Liquid Crystal Display Module

|              |                          |
|--------------|--------------------------|
| <b>NHD-</b>  | Newhaven Display         |
| <b>0208-</b> | 2 Lines x 8 Characters   |
| <b>BZ-</b>   | Model                    |
| <b>F-</b>    | Transflective            |
| <b>SW-</b>   | Side white LED Backlight |
| <b>G-</b>    | STN (+) Gray             |
| <b>B-</b>    | 6:00 Optimal View        |
| <b>W-</b>    | Wide Temperature         |
| <b>33V3-</b> | 3.3VDD, 3V Backlight     |

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## Additional Resources

- **Support Forum:** <https://support.newhavendisplay.com/hc/en-us/community/topics>
- **GitHub:** <https://github.com/newhavendisplay>
- **Example Code:** <https://support.newhavendisplay.com/hc/en-us/categories/4409527834135-Example-Code/>
- **Knowledge Center:** [https://www.newhavendisplay.com/knowledge\\_center.html](https://www.newhavendisplay.com/knowledge_center.html)
- **Quality Center:** [https://www.newhavendisplay.com/quality\\_center.html](https://www.newhavendisplay.com/quality_center.html)
- **Precautions for using LCDs/LCMs:** <https://www.newhavendisplay.com/specs/precautions.pdf>
- **Warranty / Terms & Conditions:** <https://www.newhavendisplay.com/terms.html>



## Document Revision History

| Revision | Date       | Description                                            | Changed By |
|----------|------------|--------------------------------------------------------|------------|
| 0        | 02/10/2012 | 3.3V Liquid Crystal Implemented                        | SB         |
| 1        | 01/18/2017 | Mechanical Drawing, Electrical & Optical Char. Updated | SB         |
| 2        | 10/07/2024 | AA Size Added in Mechanical Drawing                    | KL         |

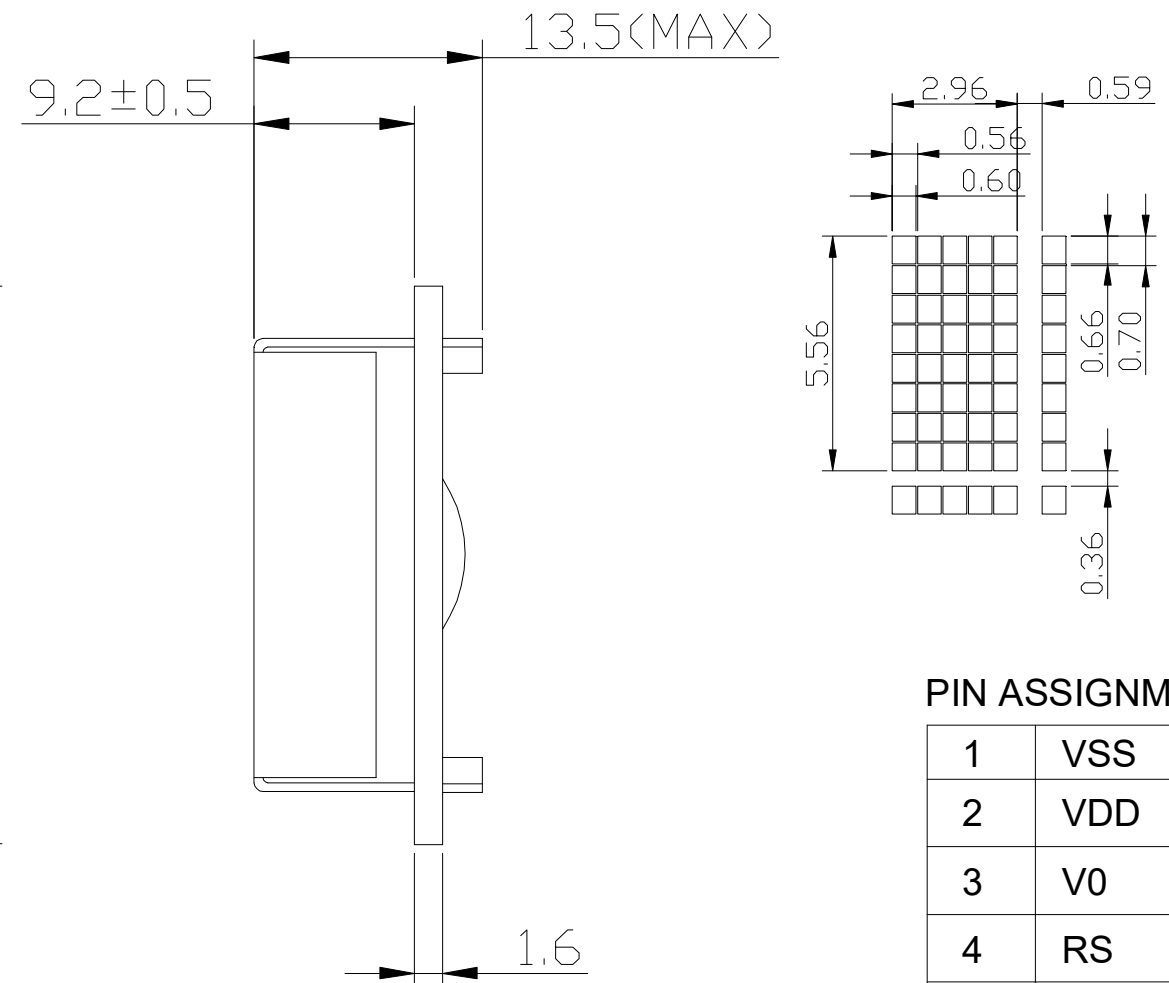
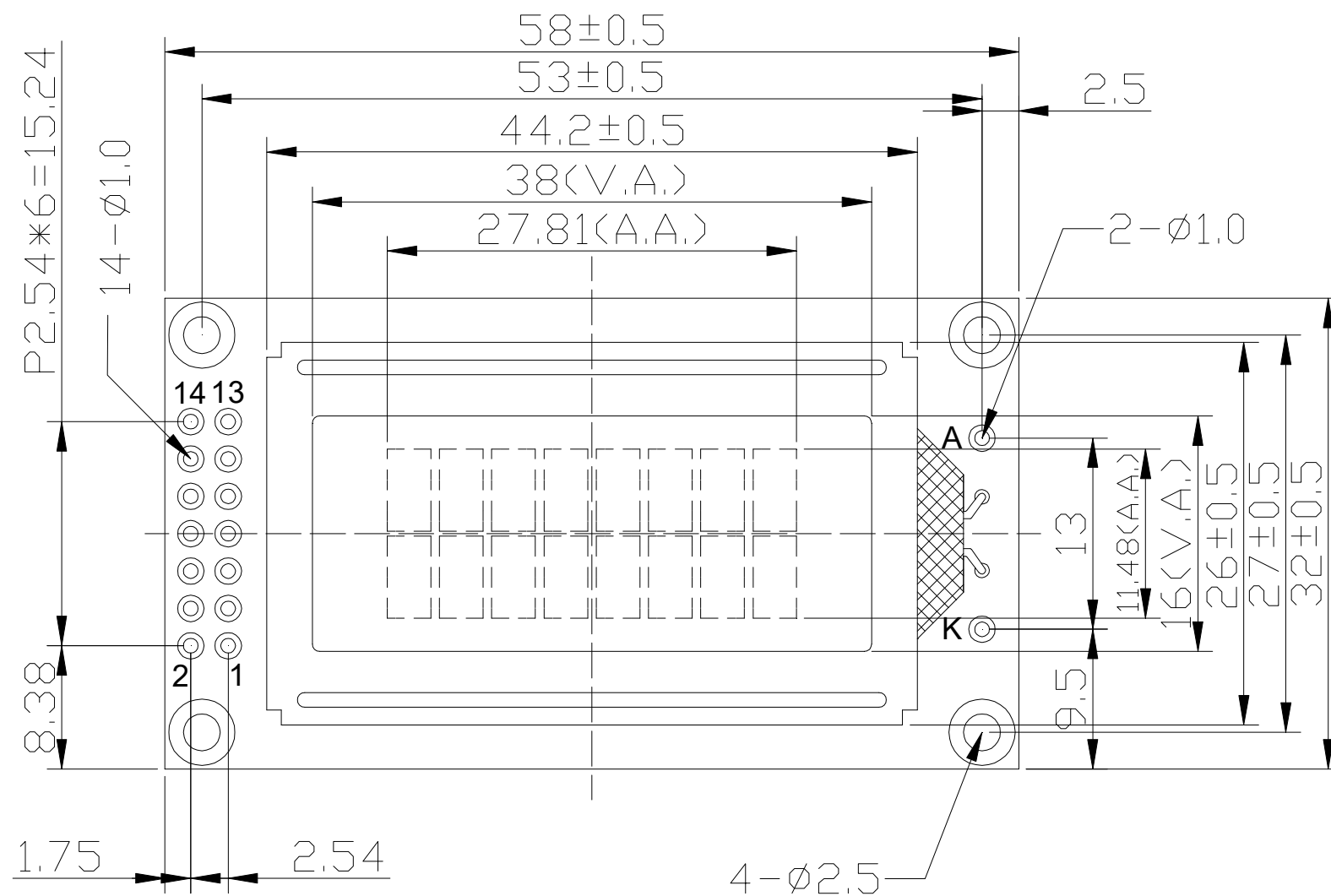
# Mechanical Drawing

Newhaven Display

NHD-0208BZ-FSW-GBW-33V3

Date Code

Part Label (type/format may vary)



## PIN ASSIGNMENT

|       |         |
|-------|---------|
| 1     | VSS     |
| 2     | VDD     |
| 3     | V0      |
| 4     | RS      |
| 5     | R/W     |
| 6     | E       |
| 7~10  | DB0~DB3 |
| 11~14 | DB4~DB7 |
| A     | LED+    |
| K     | LED-    |

Product Description: 2x8 Character LCD

1. Driver IC: ST7066U

2. Driving Mode: 1/16 Duty, 1/4 Bias

3. Interface: 4/8-bit 6800 Parallel

4. Power Requirement: 3.3V LCD, 2.9V/20mA Backlight

5. Optical Features: STN (+) Gray, Transflective, 6:00 View, White Backlight

6. Recommended Pin Header: 2x7pin 2.54mm pitch

Standard Tolerance:  
(Unless otherwise specified)

Linear: ±0.3mm

**NEWHAVEN DISPLAY**  
INTERNATIONAL

Drawing/Part Number:

NHD-0208BZ-FSW-GBW-33V3

Revision:

-

Unless otherwise specified:  
• Dimensions are in Millimeters  
• Third Angle Projection

Drawn By: K. Lewis

Drawn Date: 10/07/2024

Approved By: K. Lewis

Approved Date: 10/07/2024

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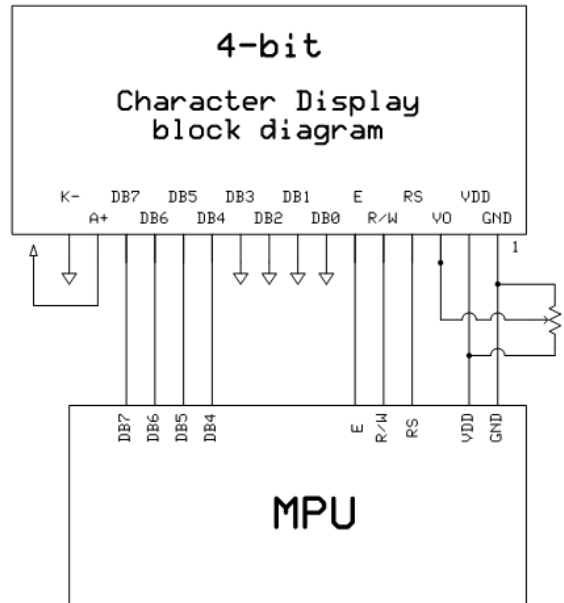
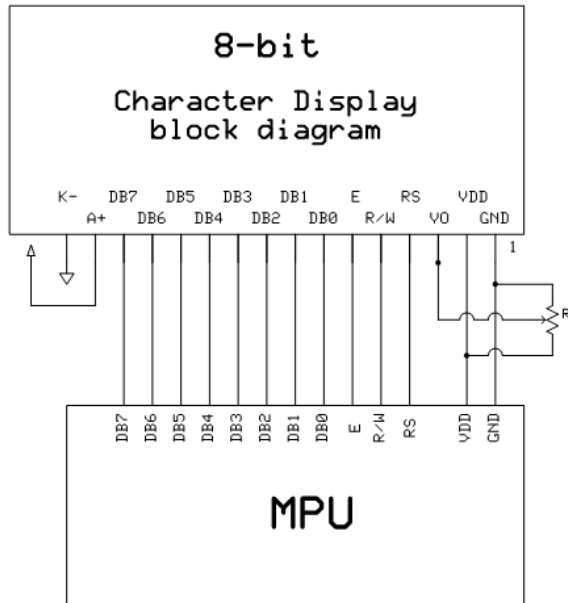
## Pin Description

| 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 logic (+3.3V)                                                                          |
| 3       | V <sub>0</sub>  | Adj Power Supply    | Supply Voltage for contrast (approx. 0.1V)                                                                |
| 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.                                                |
| A       | LED+            | Power Supply        | Power supply for LED Backlight (+2.9V)                                                                    |
| K       | LED-            | Power Supply        | Ground for Backlight                                                                                      |

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

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

## Wiring Diagram



## 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 |

## 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>  | -                                                | 3.1                  | 3.3  | 3.5                 | V    |
| Supply Current              | I <sub>DD</sub>  | V <sub>DD</sub> = 3.3V<br>T <sub>OP</sub> = 25°C | 0.5                  | 1.5  | 2.5                 | mA   |
| Supply for LCD (contrast)   | V <sub>LCD</sub> |                                                  | 3.1                  | 3.3  | 3.5                 | 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>  | -                                                | 0.75*V <sub>DD</sub> | -    | V <sub>DD</sub>     | V    |
| "L" Level output            | V <sub>OL</sub>  | -                                                | V <sub>SS</sub>      | -    | 0.2*V <sub>DD</sub> | V    |
|                             |                  |                                                  |                      |      |                     |      |
| Backlight Supply Current    | I <sub>LED</sub> | -                                                | 10                   | 20   | 25                  | mA   |
| Backlight Supply Voltage    | V <sub>LED</sub> | I <sub>LED</sub> = 20mA                          | 2.8                  | 2.9  | 3.0                 | 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    | φY+            | CR ≥ 2                 | -    | 40   | -    | °    |
|                        | Bottom | φY-            |                        | -    | 60   | -    | °    |
|                        | Left   | θX-            |                        | -    | 60   | -    | °    |
|                        | Right  | θX+            |                        | -    | 60   | -    | °    |
| Contrast Ratio         |        | CR             | -                      | 2    | 5    | -    | -    |
| Response Time          | Rise   | T <sub>R</sub> | T <sub>OP</sub> = 25°C | -    | 150  | 250  | ms   |
|                        | Fall   | T <sub>F</sub> |                        | -    | 200  | 300  | ms   |

## Controller Information

Built-in ST7066U Controller: <https://support.newhavendisplay.com/hc/en-us/articles/4414848155159-ST7066U>

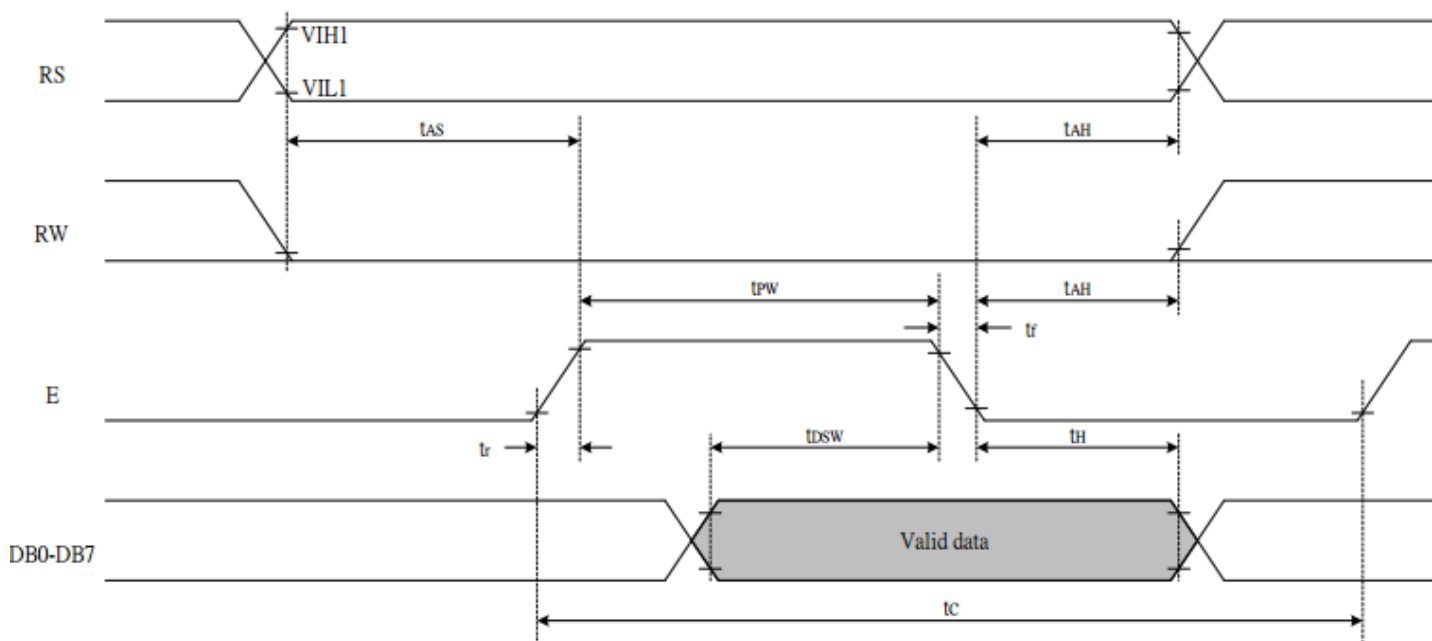


## Table of Commands

| 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                           |

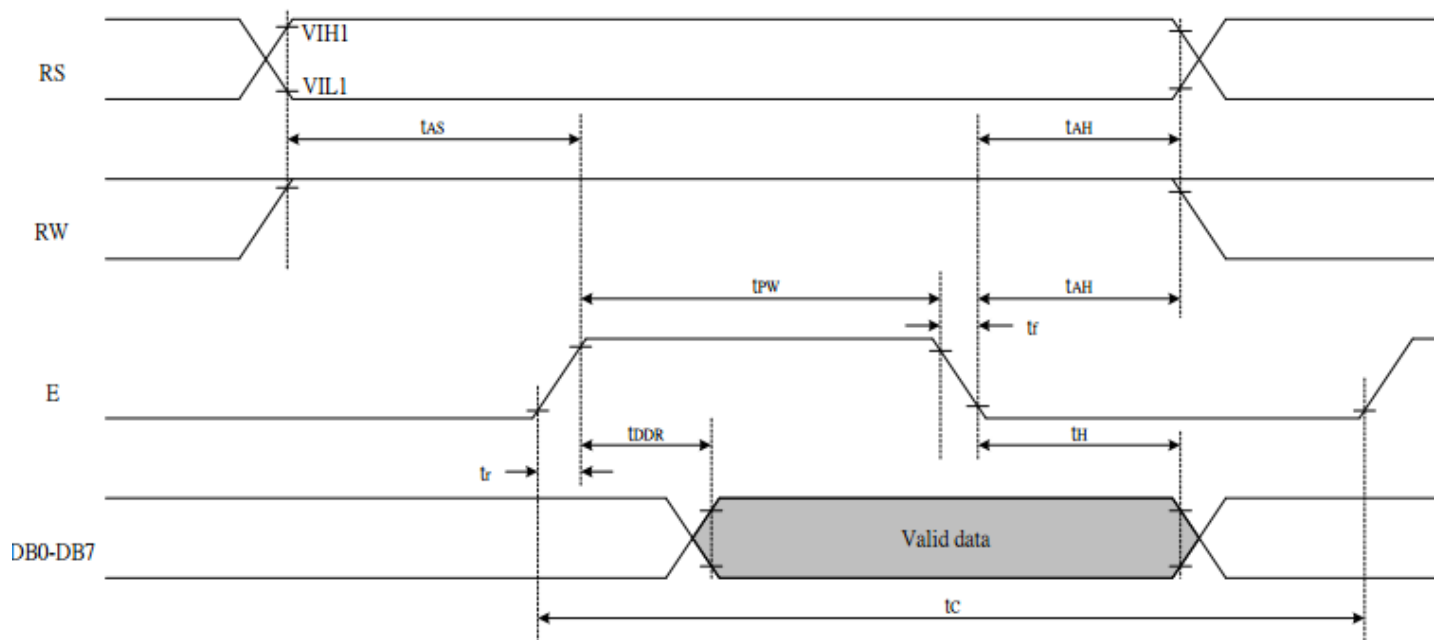
## Timing Characteristics

### Writing data from MPU to ST7066U



| Write Mode (Writing data from MPU to ST7066U) |                       |                 |      |   |    |    |
|-----------------------------------------------|-----------------------|-----------------|------|---|----|----|
| $T_C$                                         | 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 | 0    | - | -  | ns |
| $T_{AH}$                                      | Address Hold Time     | Pins: RS, RW, E | 10   | - | -  | ns |
| $T_{DSW}$                                     | Data Setup Time       | Pins: DB0 - DB7 | 40   | - | -  | ns |
| $T_H$                                         | 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           | 140  | - | -   | 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 | -    | - | 100 | 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    |
| 0001           | (2)              |      | .    | A    | B    | C    | D    | E    |      |      | F    | G    | H    | I    | J    | K    |
| 0010           | (3)              |      | "    | 2    | B    | R    | b    | r    |      |      | "    | 4    | U    | X    | P    | 0    |
| 0011           | (4)              |      | #    | 3    | C    | S    | c    | s    |      |      | 7    | 0    | T    | E    | E    | W    |
| 0100           | (5)              |      | \$   | 4    | D    | T    | d    | t    |      |      | <    | I    | t    | P    | u    | a    |
| 0101           | (6)              |      | %    | 5    | E    | U    | e    | u    |      |      | *    | 7    | 7    | 1    | e    | 0    |
| 0110           | (7)              |      | &    | 6    | F    | V    | f    | v    |      |      | 9    | 0    | =    | 3    | P    | Z    |
| 0111           | (8)              |      | '    | 7    | G    | W    | g    | w    |      |      | 7    | *    | X    | 7    | g    | x    |
| 1000           | (1)              |      | (    | 8    | H    | X    | h    | x    |      |      | 4    | 0    | *    | U    | r    | X    |
| 1001           | (2)              |      | )    | 9    | I    | Y    | i    | y    |      |      | 6    | 7    | 7    | u    | 7    | y    |
| 1010           | (3)              |      | *    | :    | J    | Z    | j    | z    |      |      | =    | 3    | 0    | V    | j    | 7    |
| 1011           | (4)              |      | +    | :    | K    | L    | k    | l    |      |      | *    | 7    | E    | 0    | *    | 7    |
| 1100           | (5)              |      | ,    | <    | L    | *    | 1    | 1    |      |      | 7    | 3    | 7    | 7    | *    | 7    |
| 1101           | (6)              |      | -    | =    | N    | J    | n    | >    |      |      | u    | X    | >    | 7    | 7    | ÷    |
| 1110           | (7)              |      | .    | >    | N    | ^    | n    | ÷    |      |      | 3    | E    | 7    | 7    | 7    |      |
| 1111           | (8)              |      | /    | ?    | 0    | _    | o    | *    |      |      | u    | 7    | 7    | 7    | 7    |      |

## 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.                                                                              | V <sub>s</sub> =800V, R <sub>s</sub> =1.5kΩ, C <sub>s</sub> =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.