

# NHD-C0220AZ-FSW-FTW

## COG (Chip-on-Glass) Liquid Crystal Display Module

|        |                              |
|--------|------------------------------|
| NHD-   | Newhaven Display             |
| C0220- | COG, 2 Lines x 20 Characters |
| AZ-    | Model                        |
| F-     | Transflective                |
| SW-    | Side White LED Backlight     |
| F-     | FSTN Positive                |
| T-     | 12:00 Optimum Viewing Angle  |
| W-     | Wide Temp                    |
|        | <b>RoHS Compliant</b>        |

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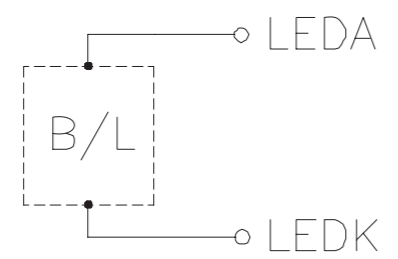
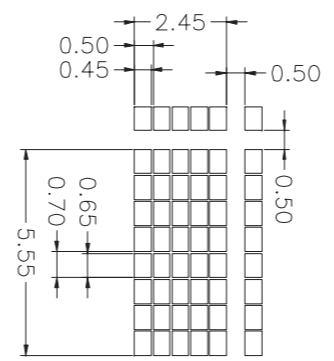
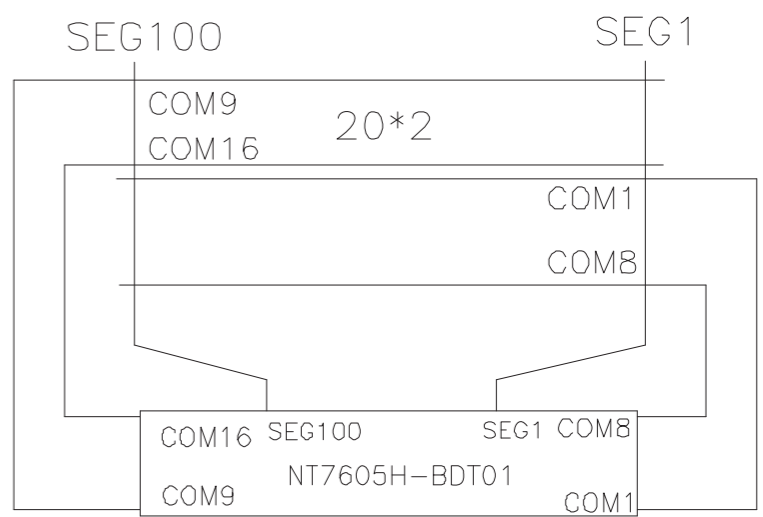
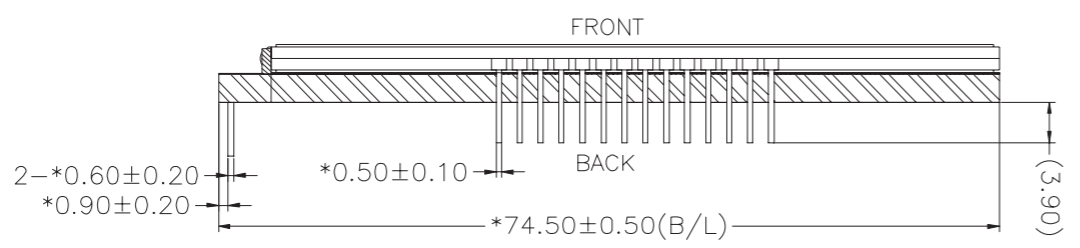
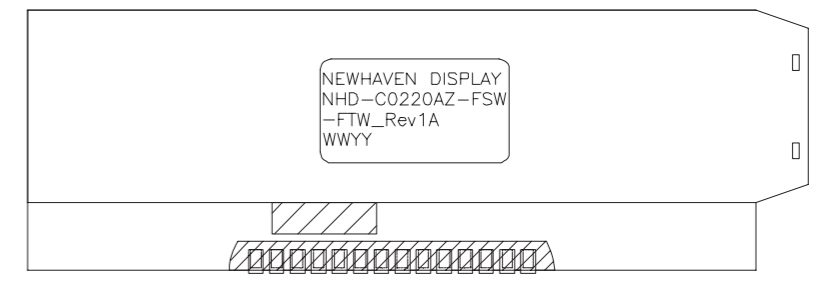
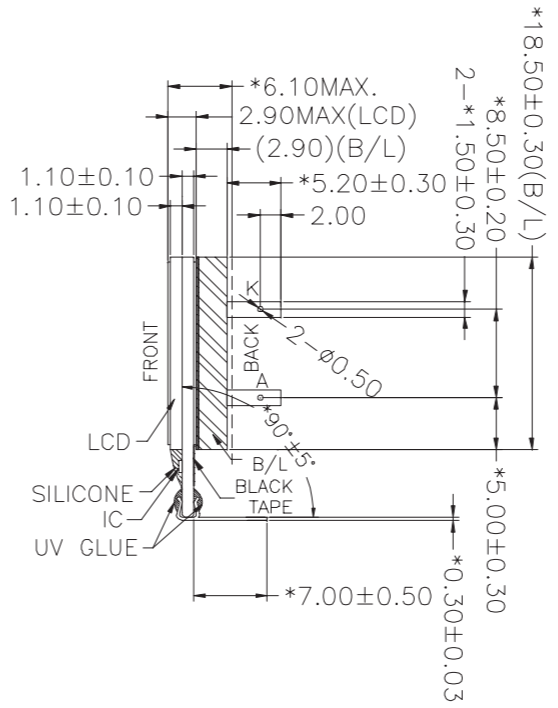
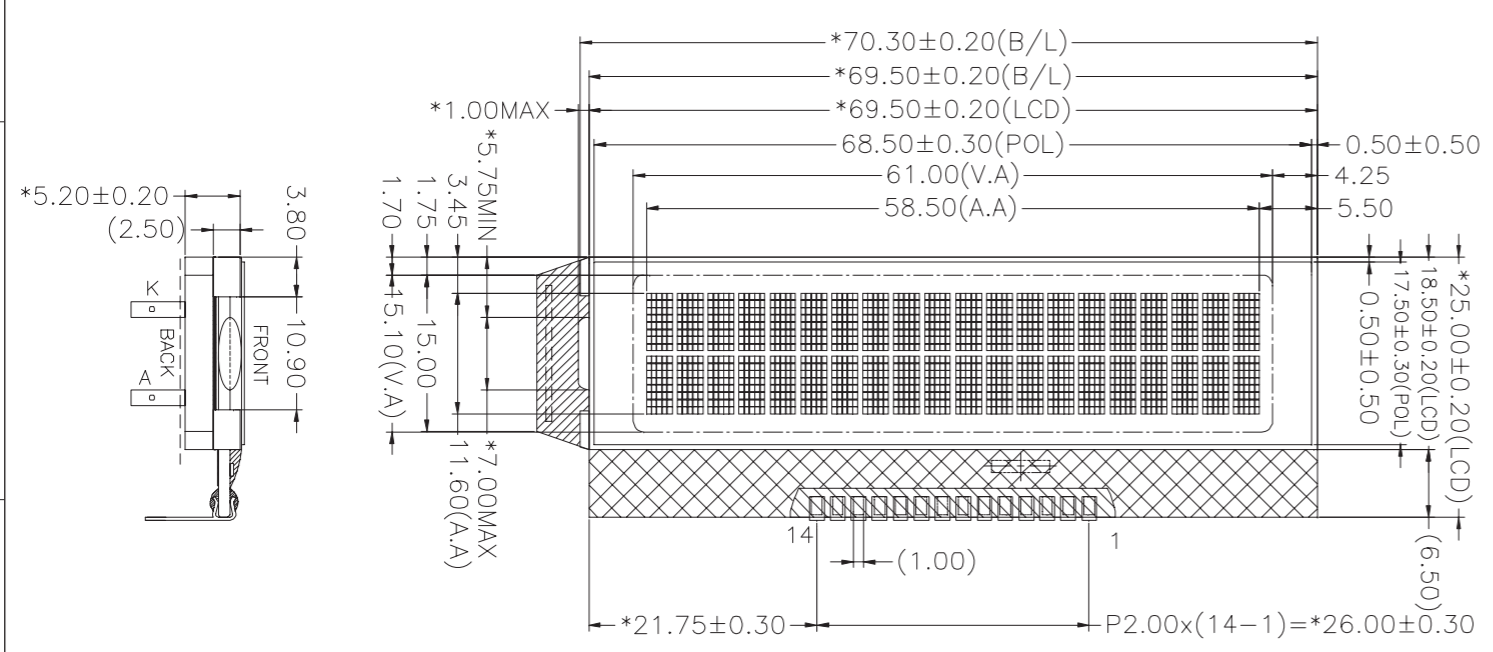
## Document Revision History

| Revision | Date       | Description  | Changed by |
|----------|------------|--|------------|
| 0        | 7/20/2008  | Initial Release  |            |
| 1        | 6/29/2009  | User guide reformat  | BE         |
| 2        | 10/9/2009  | Updated Electrical Characteristics                                 | MC         |
| 3        | 11/16/2009 | Min Supply Voltage = 3.3V, Max VLCD = 5.0V                         | CL         |
| 4        | 11/19/2009 | Updated backlight supply current                                   | MC         |
| 5        | 5/14/2010  | Controller Note  | MP         |
| 6        | 3/14/2011  | Update VLCD  | CL         |
| 7        | 5/27/2011  | Display character address code updated                             | AK         |
| 8        | 6/2/2011   | Timing characteristics updated                                     | AK         |
| 9        | 8/1/2011   | Improve backlight, add orientation tabs                            | CL         |
| 10       | 9/28/2015  | Electrical characteristics updated, mechanical drawing reformatted | SB         |
| 11       | 12/1/17    | Electrical Characteristics Updated                                 | SB         |
| 12       | 7/5/19     | Added PCB Footprint Drawing  | AS         |

## Functions and Features

- 2 lines x 20 characters
- Built-in NT7605 controller
- 5V power supply
- 1/16 duty, 1/5 bias

| SYMBOL | REVISION | DATE |
|--------|----------|------|
|        |          |      |



CONSTANT CURRENT: 30mA, 3.00±0.20V  
BACKLIGHT DRIVER CIRCUIT DIAGRAM

| ITEM                  | PARAMETERS          | ITEM                  | PARAMETERS           |
|-----------------------|---------------------|-----------------------|----------------------|
| DISPLAY TYPE          | FSTN, POSITIVE      | VIEWING DIRECTION     | 12 O'CLOCK           |
| DRIVING METHOD        | 1/16 DUTY, 1/5 BIAS | OPERATING TEMPERATURE | -20°C TO +70°C       |
| POLARIZER TYPE        | TRANSFLECTIVE       | STORAGE TEMPERATURE   | -30°C TO +80°C       |
| LCD OPERATING VOLTAGE | 4.4V                | IC                    | NT7605H-BDT01        |
| LOGIC VOLTAGE(VDD)    | 5.0V                | BACKLIGHT             | EDGE, WHITE (2 LEDS) |

## Pin Assignments

|            |     |     |     |     |     |     |     |
|------------|-----|-----|-----|-----|-----|-----|-----|
| PIN        | 1   | 2   | 3   | 4   | 5   | 6   | 7   |
| CONNECTION | GND | V5  | VDD | RS  | R/W | E   | DB0 |
| PIN        | 8   | 9   | 10  | 11  | 12  | 13  | 14  |
| CONNECTION | DB1 | DB2 | DB3 | DB4 | DB5 | DB6 | DB7 |

STANDARD TOLERANCES (UNLESS OTHERWISE SPECIFIED)

LINEAR:  
 XX. ±0.3 mm  
 XX.X ±0.3 mm  
 XX.XX ±0.3 mm

UNLESS OTHERWISE SPECIFIED  
 - DIMENSIONS ARE IN MILLIMETERS  
 - THIRD ANGLE PROJECTION

**NEWHAVEN DISPLAY INTERNATIONAL**

DRAWING/PART NUMBER:  
**NHD-C0220AZ-FSW-FTW**

REVISION: 1.0  
 SIZE: A3  
 SCALE: SB

APPROVED BY: T. Tung  
 CHECKED BY: S. Baxi  
 DRAWN BY: S. Baxi

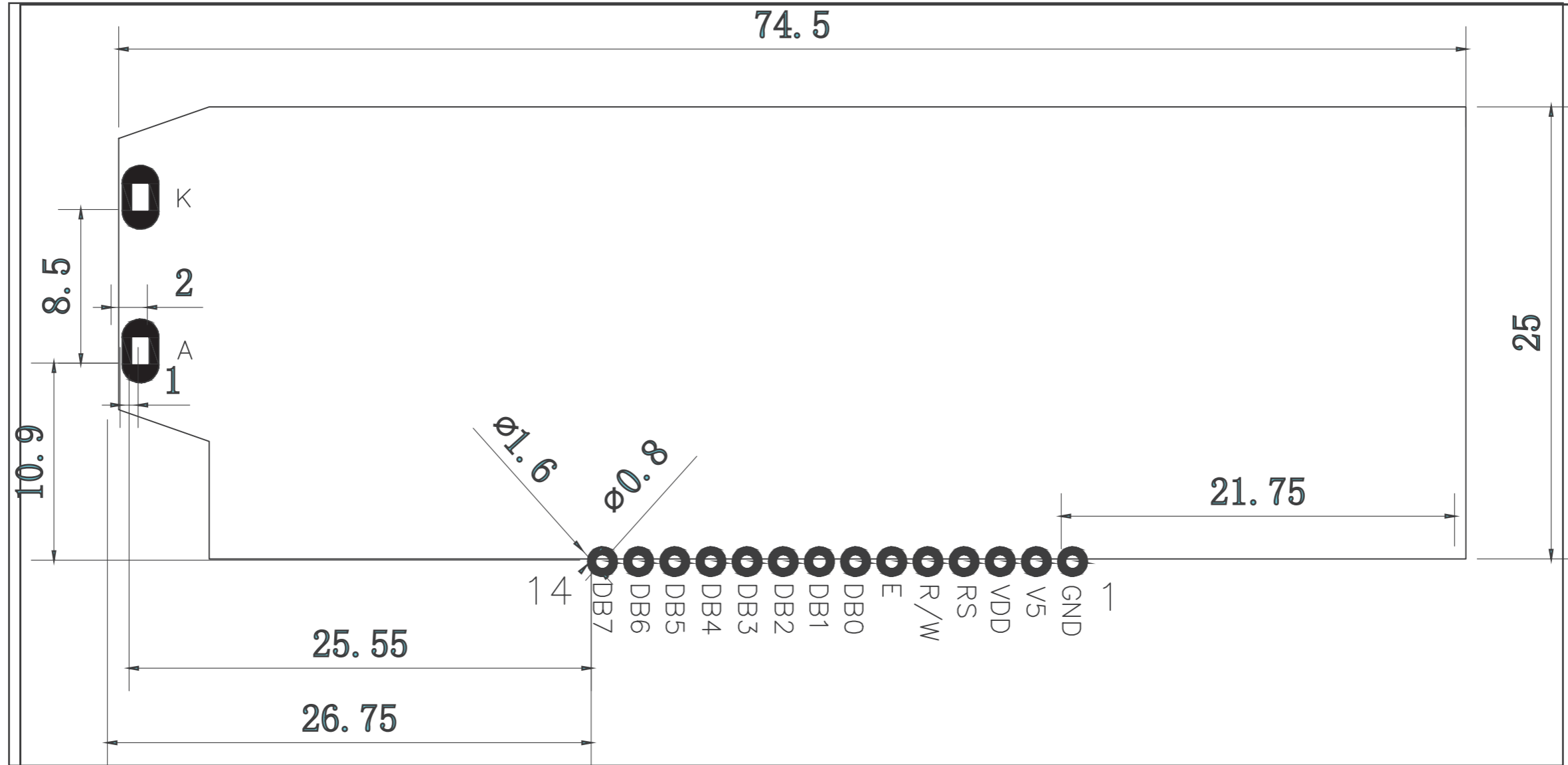
APPROVED DATE: 12/28/17  
 CHECKED DATE: 12/28/17  
 DRAWN DATE: 12/28/17

DO NOT SCALE DRAWING SHEET 1 OF 1

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# Recommended PCB Footprint

| SYMBOL | REVISION | DATE |
|--------|----------|------|
|        |          |      |
|        |          |      |



Applicable Displays:  
 1) NHD-C0220AA-FSW-FTW  
 2) NHD-C0220AZ-FSW-FTW

|   |  |  |                          |
|---|--|--|--------------------------|
| STANDARD TOLERANCE:<br>(UNLESS OTHERWISE SPECIFIED)   |  |  |                          |
| LINEAR: ±0.3mm  |  | DRAWING/PART NUMBER:<br>NHD-C0220(AZ&AA) Footprint |                          |
| UNLESS OTHERWISE SPECIFIED:<br>- DIMENSIONS ARE IN MILLIMETERS<br>- THIRD ANGLE PROJECTION  |  | DRAWN BY:<br>A. Shah                               | APPROVED BY:<br>A. Khan  |
|   |  | DRAWN DATE:<br>7/1/19                              | APPROVED DATE:<br>7/1/19 |
|   |  | DO NOT SCALE DRAWING                               |                          |
|   |  | SHEET 1 OF 1                                       |                          |
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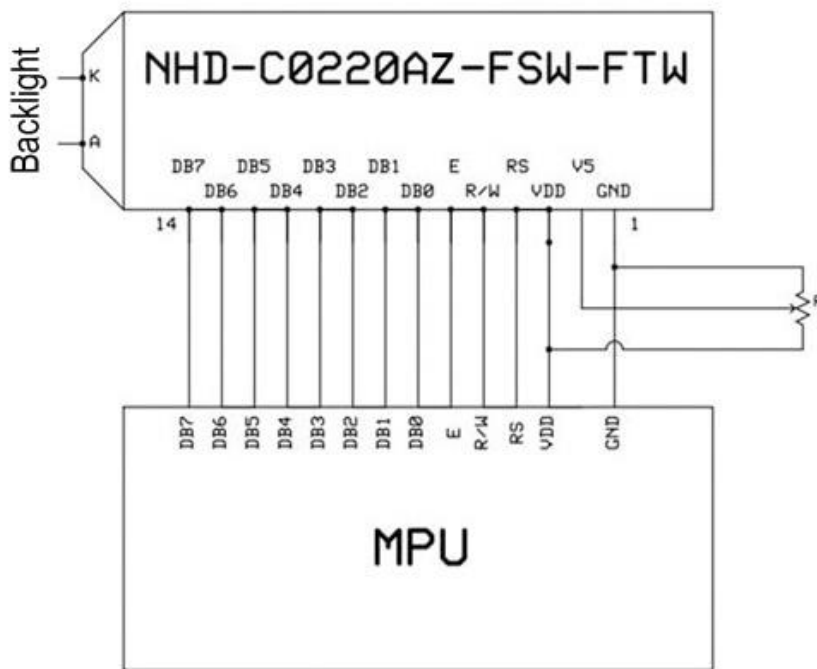
## Pin Description and Wiring Diagram

| Pin No. | Symbol          | External Connection | Function Description  |
|---------|-----------------|---------------------|---|
| 1       | GND             | Power Supply        | Ground  |
| 2       | V <sub>s</sub>  | Adj. Power Supply   | Supply Voltage for Contrast (approx. 0.6V)  |
| 3       | V <sub>DD</sub> | Power Supply        | Supply Voltage for LCD and Logic  |
| 4       | RS              | MPU                 | Register Select: 0=Instruction, 1=Data  |
| 5       | R/W             | MPU                 | Read / Write select: 0=Write, 1=Read  |
| 6       | E               | MPU                 | Operation Enable Signal.  |
| 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        | Backlight Anode (30 mA @ 3V)  |
| K       | LED -           | Power Supply        | Backlight Cathode (Ground)  |

**Recommended LCD connector:** 2.0mm pitch, 14pins Soldered to PCB, or JST p/n: PHR-14

**Backlight connector:** A and K pins **Mates with:** Solder to wires or PCB

**Recommended Breakout Board:** [NHD-PCB40](#)



## 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<br>T <sub>OP</sub> = 25°C | 0.7                   | 1.5  | 2.5                   | mA   |
| Supply for LCD (contrast)   | V <sub>DD</sub> - V <sub>5</sub> |  | 4.1                   | 4.4  | 4.7                   | V    |
| "H" Level input             | V <sub>IH</sub>                  | -  | 0.8 * V <sub>DD</sub> | -    | V <sub>DD</sub>       | V    |
| "L" Level input             | V <sub>IL</sub>                  | -  | 0                     | -    | 0.2 * V <sub>DD</sub> | V    |
| "H" Level output            | V <sub>OH</sub>                  | -  | V <sub>DD</sub> - 0.6 | -    | V <sub>DD</sub>       | V    |
| "L" Level output            | V <sub>OL</sub>                  | -  | GND                   | -    | GND + 0.6             | V    |
|                             |                                  |  |                       |      |                       |      |
| Backlight Supply Current    | I <sub>LED</sub>                 | -  | -                     | 30   | 36                    | mA   |
| Backlight Supply Voltage    | V <sub>LED</sub>                 | I <sub>LED</sub> = 30 mA                         | 2.9                   | 3.0  | 3.2                   | V    |

\*The LED of the backlight is driven by current; 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 | Vertical       | CR ≥ 2    | -20  | -    | 20   | °    |
|                        | Horizontal     |           | θX   | -30  | -    | 30   |
| Contrast Ratio         | CR             | -         | -    | 6    | -    |      |
| Response Time (rise)   | T <sub>R</sub> | -         | -    | 100  | 160  | ms   |
| Response Time (fall)   | T <sub>F</sub> | -         | -    | 150  | 200  | ms   |

## Controller Information

Built-in NT7605H-BDT01 controller.

Please download specification at [http://www.newhavendisplay.com/app\\_notes/NT7605.pdf](http://www.newhavendisplay.com/app_notes/NT7605.pdf)

**NOTE:** The Busy Flag of the NT7605 controller may not always be responsive. Add sufficient delays and/or a time-out check routine to continue operation if busy flag is not cleared.

Note: during internal operation, busy flag (DB7) is read "High".  
 Busy flag check must be preceded by the next instruction.

## DDRAM Address

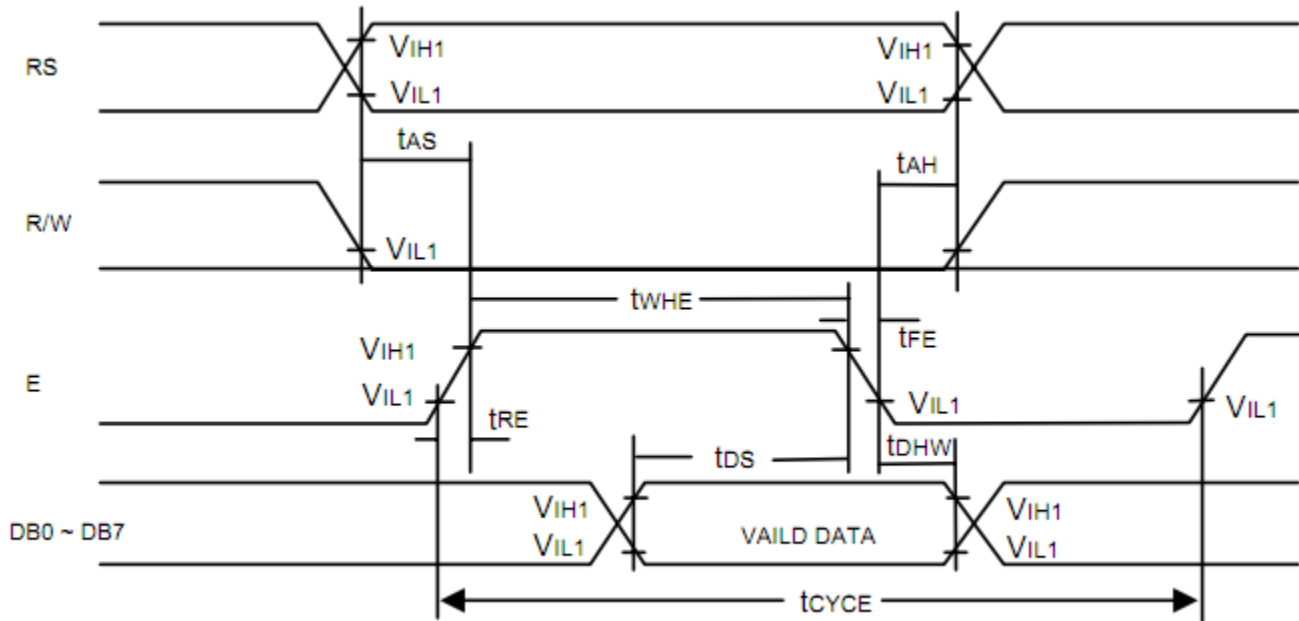
|    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |
|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|
| 1  | 2  | 3  | 4  | 5  | 6  | 7  | 8  | 9  | 10 | 11 | 12 | 13 | 14 | 15 | 16 | 17 | 18 | 19 | 20 |
| 00 | 01 | 02 | 03 | 04 | 05 | 06 | 07 | 08 | 09 | 0A | 0B | 0C | 0D | 0E | 0F | 10 | 11 | 12 | 13 |
| 40 | 41 | 42 | 43 | 44 | 45 | 46 | 47 | 48 | 49 | 4A | 4B | 4C | 4D | 4E | 4F | 50 | 51 | 52 | 53 |

## Table of Commands

| Instruction                        | INSTRUCTION CODE  |     |            |     |     |     |     |     |   |  | Description  | Execution Time (Max)<br>(fosc = 540KHZ)   |        |
|------------------------------------|---|-----|------------|-----|-----|-----|-----|-----|---|--|--|---|--------|
|                                    | RS  | R/W | DB7        | DB6 | DB5 | DB4 | DB3 | DB2 | DB1   | DB0  |  |   |        |
| Clear Display                      | 0   | 0   | 0          | 0   | 0   | 0   | 0   | 0   | 0   | 0  | 1  | Clear entire display area. Restore display from shift, and load address counter with DDRAM address 00H                        | 1.64ms |
| Display/<br>Cursor Home            | 0   | 0   | 0          | 0   | 0   | 0   | 0   | 0   | 0   | 1  | -  | Restore display from shift and load address counter with DDRAM address 00H  | 1.64ms |
| Entry mode Set                     | 0   | 0   | 0          | 0   | 0   | 0   | 0   | 0   | 1   | I/D  | S  | Specify direction of cursor movement and display shift mode. This operation takes place after each data transfer (read/write) | 40μs   |
| Display ON/<br>OFF control         | 0   | 0   | 0          | 0   | 0   | 0   | 0   | 1   | D   | C  | B  | Set activation of display (D), cursor (C), and Blinking of cursor (B)   | 40μs   |
| Display/<br>Cursor                 | 0   | 0   | 0          | 0   | 0   | 0   | 1   | S/C | R/L   | -  | -  | Shift display or move cursor  | 40μs   |
| Function set                       | 0   | 0   | 0          | 0   | 1   | DL  | N   | F   | -   | -  | -  | Set interface data length (DL) number of the display line (N), and character font (F)   | 40μs   |
| RAM Address Set                    | 0   | 0   | 0          | 1   | ACG |     |     |     |   |  | Set CGRAM address in address counter.  | 40μs  |        |
| DDRAM Address Set                  | 0   | 0   | 1          | ADD |     |     |     |     |   | Set DDRAM address in address counter.                    | 40μs   |   |        |
| Busy Flag/<br>Address Counter Read | 0   | 1   | BF         | AC  |     |     |     |     |   | Read Busy Flag (BF) and contents of Address Counter (AC) | 1μs  |   |        |
| CGRAM/<br>DDRAM Data Write         | 1   | 0   | Write Data |     |     |     |     |     | Write data into internal RAM (DDRAM/CGRAM). | 40μs   |  |   |        |
| CGRAM/<br>DDRAM Data Read          | 1   | 1   | Read Data  |     |     |     |     |     | Read data from internal RAM (DDRAM/CGRAM).  | 40μs   |  |   |        |
|                                    | I/D = 1 : Increment                      I/D = 0 : Decrement<br>S = 1 : Display Shift On<br>D = 1 : Display On<br>C = 1 : Cursor Display On<br>B = 1 : Cursor Blink On<br>S/C = 1 : Shift Display                      S/C = 0 : Move Cursor<br>R/L = 1 : Shift Right                      R/L = 0 : Shift Left<br>DL = 1 : 8-Bit                                  DL = 0 : 4-Bit<br>N = 1 : Dual Line                              N = 0 : Single Line<br>F = 1 : 5x10 dots                              F = 0 : 5x8 dots<br>BF = 1 : Internal Operation<br>BF = 0 : Ready for Instruction |     |            |     |     |     |     |     |   |  | DDRAM : Display Data Ram<br><br>CGRAM : Character Generator RAM<br><br>ACG : Character Generator RAM Address<br><br>ADD : Display Data RAM Address<br><br>AC : Address Counter |   |        |

# Timing Characteristics

## Write from MPU to NT7605



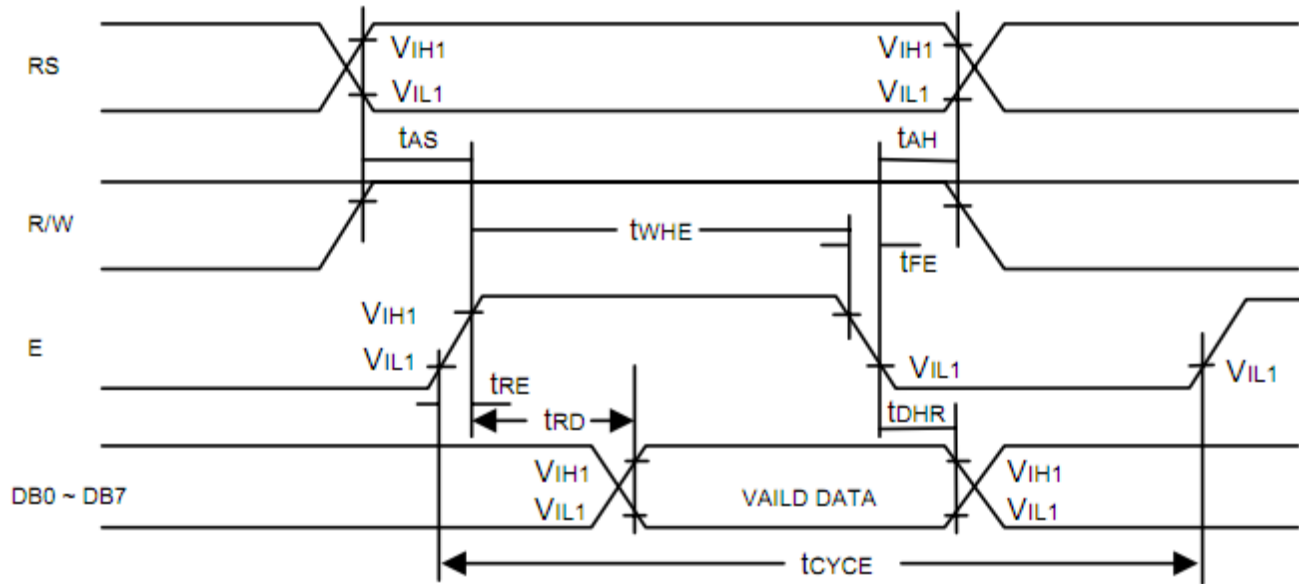
Write Cycle ( $V_{DD} = 4.5V \sim 5.5V$ ,  $GND = 0V$ ,  $T_A = 25^\circ C$ )

| Symbol           | Parameter                    | Min.    | Typ. | Max. | Unit | Conditions |
|------------------|------------------------------|---------|------|------|------|------------|
| $t_{CYCE}$       | Enable Cycle Time            | 500     | -    | -    | ns   | Figure 2   |
| $t_{wHE}$        | Enable "H" Level Pulse Width | 300     | -    | -    | ns   | Figure 2   |
| $t_{RE}, t_{FE}$ | Enable Rise/Fall Time        | -       | -    | 25   | ns   | Figure 2   |
| $t_{AS}$         | RS, RW Setup Time            | $60^1$  | -    | -    | ns   | Figure 2   |
|                  |                              | $100^2$ |      |      |      |            |
| $t_{AH}$         | RS, RW Address Hold Time     | 10      | -    | -    | ns   | Figure 2   |
| $t_{DS}$         | Data Output Delay            | 100     | -    | -    | ns   | Figure 2   |
| $t_{dHW}$        | Data Hold Time               | 10      | -    | -    | ns   | Figure 2   |

Notes: 1: 8-bit operation mode  
2: 4-bit operation mode



## Read from NT7605 to MPU



Read Cycle ( $V_{DD} = 4.5V \sim 5.5V$ ,  $GND = 0V$ ,  $T_A = 25^\circ C$ )

| Symbol   | Parameter                    | Min.             | Typ. | Max. | Unit | Conditions |
|----------|------------------------------|------------------|------|------|------|------------|
| tCYCE    | Enable Cycle Time            | 500              | -    | -    | ns   | Figure 1   |
| twHE     | Enable "H" Level Pulse Width | 300              | -    | -    | ns   | Figure 1   |
| tRE, tFE | Enable Rise/Fall Time        | -                | -    | 25   | ns   | Figure 1   |
| tAS      | RS, R/W Setup Time           | 60 <sup>1</sup>  | -    | -    | ns   | Figure 1   |
|          |                              | 100 <sup>2</sup> |      |      |      |            |
| tAH      | RS, R/W Address Hold Time    | 10               | -    | -    | ns   | Figure 1   |
| trD      | Read Data Output Delay       | -                | -    | 190  | ns   | Figure 1   |
| tdHR     | Read Data Hold Time          | 20               | -    | -    | ns   | Figure 1   |

Notes: 1: 8-bit operation mode

2: 4-bit operation mode

## Built-in Font Table

| Lower 4 Bits \ Upper 4 Bits | 0000       | 0001 | 0010 | 0011 | 0100 | 0101 | 0110 | 0111 | 1000 | 1001 | 1010 | 1011 | 1100 | 1101 | 1110 | 1111 |
|-----------------------------|------------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|
| xxxx0000                    | CG RAM (1) |      |      | 0    | a    | P    | `    | P    |      |      |      | -    | 夕    | 三    | α    | ρ    |
| xxxx0001                    | (2)        |      | !    | 1    | A    | Q    | a    | q    |      |      | 。    | ア    | チ    | △    | △    | q    |
| xxxx0010                    | (3)        |      | "    | 2    | B    | R    | b    | r    |      |      | 「    | イ    | ツ    | ×    | ρ    | θ    |
| xxxx0011                    | (4)        |      | #    | 3    | C    | S    | c    | s    |      |      | 」    | ウ    | テ    | モ    | ε    | ∞    |
| xxxx0100                    | (5)        |      | \$   | 4    | D    | T    | d    | t    |      |      | 、    | エ    | ト    | カ    | μ    | Ω    |
| xxxx0101                    | (6)        |      | %    | 5    | E    | U    | e    | u    |      |      | ・    | オ    | ナ    | 1    | ε    | ü    |
| xxxx0110                    | (7)        |      | &    | 6    | F    | V    | f    | v    |      |      | ヲ    | カ    | ニ    | ヨ    | ρ    | Σ    |
| xxxx0111                    | (8)        |      | '    | 7    | G    | W    | g    | w    |      |      | ヲ    | キ    | ヌ    | ラ    | g    | π    |
| xxxx1000                    | (1)        |      | <    | 8    | H    | X    | h    | x    |      |      | イ    | ク    | ネ    | リ    | γ    | ∞    |
| xxxx1001                    | (2)        |      | >    | 9    | I    | Y    | i    | y    |      |      | ウ    | ケ    | ノ    | ル    | '    | γ    |
| xxxx1010                    | (3)        |      | *    | :    | J    | Z    | j    | z    |      |      | エ    | コ    | ハ    | レ    | j    | ≠    |
| xxxx1011                    | (4)        |      | +    | ;    | K    | [    | k    | <    |      |      | オ    | サ    | ヒ    | ロ    | *    | ≠    |
| xxxx1100                    | (5)        |      | ,    | <    | L    | ¥    | l    | l    |      |      | カ    | シ    | フ    | ワ    | φ    | 円    |
| xxxx1101                    | (6)        |      | -    | =    | M    | ]    | m    | >    |      |      | ユ    | ス    | ハ    | ン    | も    | ÷    |
| xxxx1110                    | (7)        |      | .    | >    | N    | ^    | n    | →    |      |      | ヨ    | セ    | ホ    | °    | °    |      |
| xxxx1111                    | (8)        |      | /    | ?    | O    | _    | o    | €    |      |      | ッ    | ソ    | マ    | °    | ö    | ■    |

## Example Initialization Program

```
'INIT-----  
A = &H30  
Call Writecom                                     'wake up  
Waitms 100  
Call Writecom                                     'wake up  
Waitms 10  
Call Writecom                                     'wake up  
Waitms 10  
A = &H38  
'function set  
Call Writecom  
A = &H10  
'shift display=no  
Call Writecom  
A = &H0C  
'display on  
Call Writecom  
A = &H06  
'entry mode set  
Call Writecom  
'-----  
Sub Writecom  
P1 = A  
Reset P3.0  
'instruction  
Reset P3.7  
'RW  
Waitms 1  
Set P3.4  
'E  
Waitms 1  
Reset P3.4                                     'E  
End Sub  
'-----  
Sub Writedata  
P1 = A  
Set P3.0  
'data  
Reset P3.7  
'RW  
Waitms 1  
Set P3.4  
'E  
Waitms 1  
Reset P3.4                                     'E  
End Sub  
'-----
```

## 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 , 120 Hrs.   | 2    |
| Low Temperature storage               | Endurance test applying the low storage temperature for a long time.  | -30°C , 120 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 , 120 Hrs.   | 2    |
| Low Temperature Operation             | Endurance test applying the electric stress (voltage & current) and the low thermal stress for a long time.                     | -20°C , 120 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. | +40°C , 90% RH , 120 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<br>10 cycles                        |      |
| Vibration test                        | Endurance test applying vibration to simulate transportation and use.   | 10-55Hz , 1.5mm 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.  | Air Discharge= ±8kV,<br>Contact Discharge = ±4kV<br>Five 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)