

Product Specification

NHD-2.7-12864WDY3-M

Graphic OLED Display Module

| | |
|---------------|--|
| NHD- | Newhaven Display |
| 2.7- | 2.7" Diagonal Size |
| 12864- | 128x64 Pixel Resolution |
| WD- | Model |
| Y- | Emitting Color: Yellow |
| 3- | 3.3V Power Supply |
| M- | Molex (52271-2079) Connector Interface |

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Additional Resources

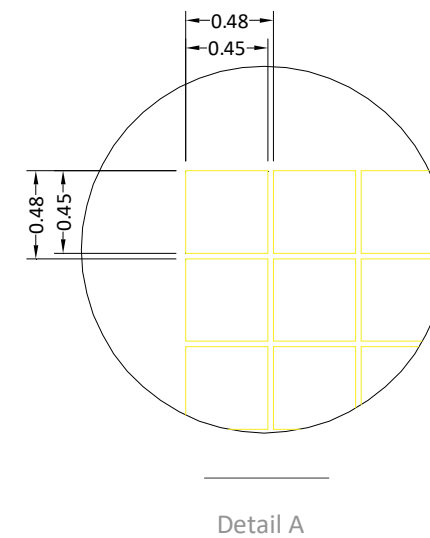
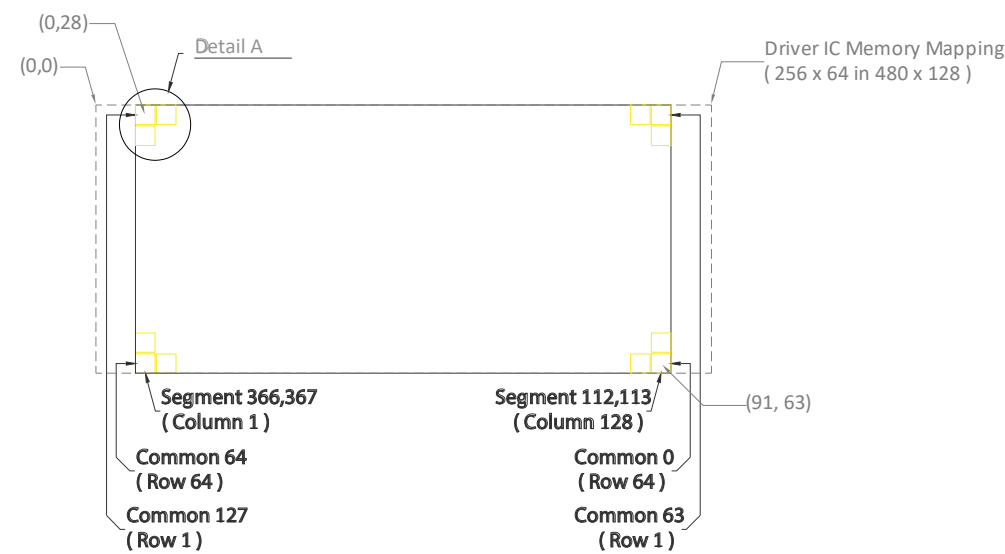
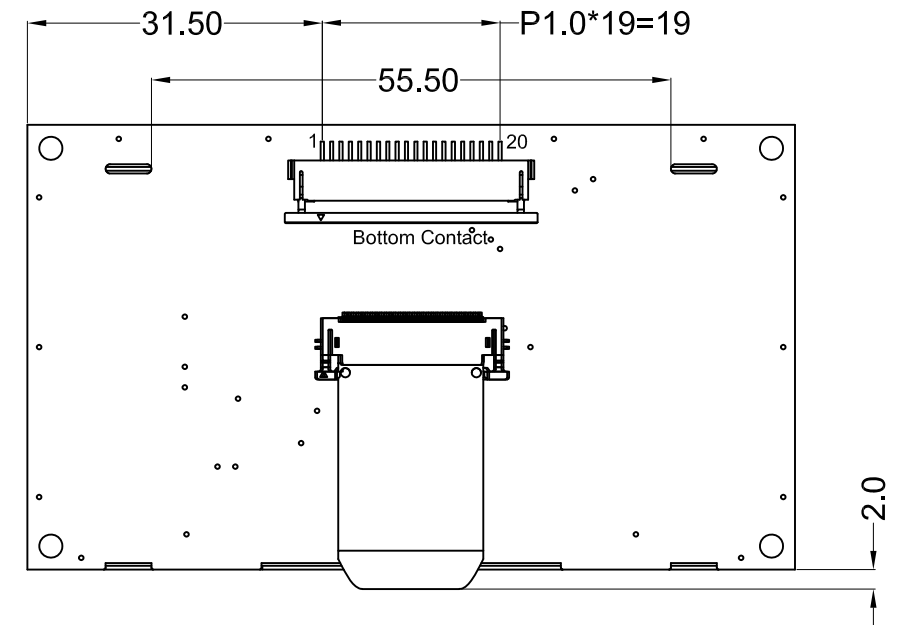
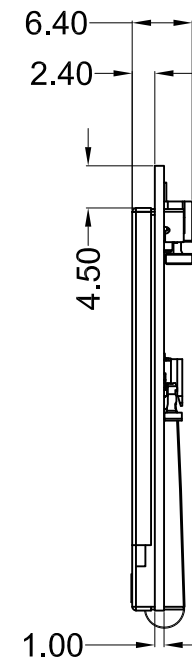
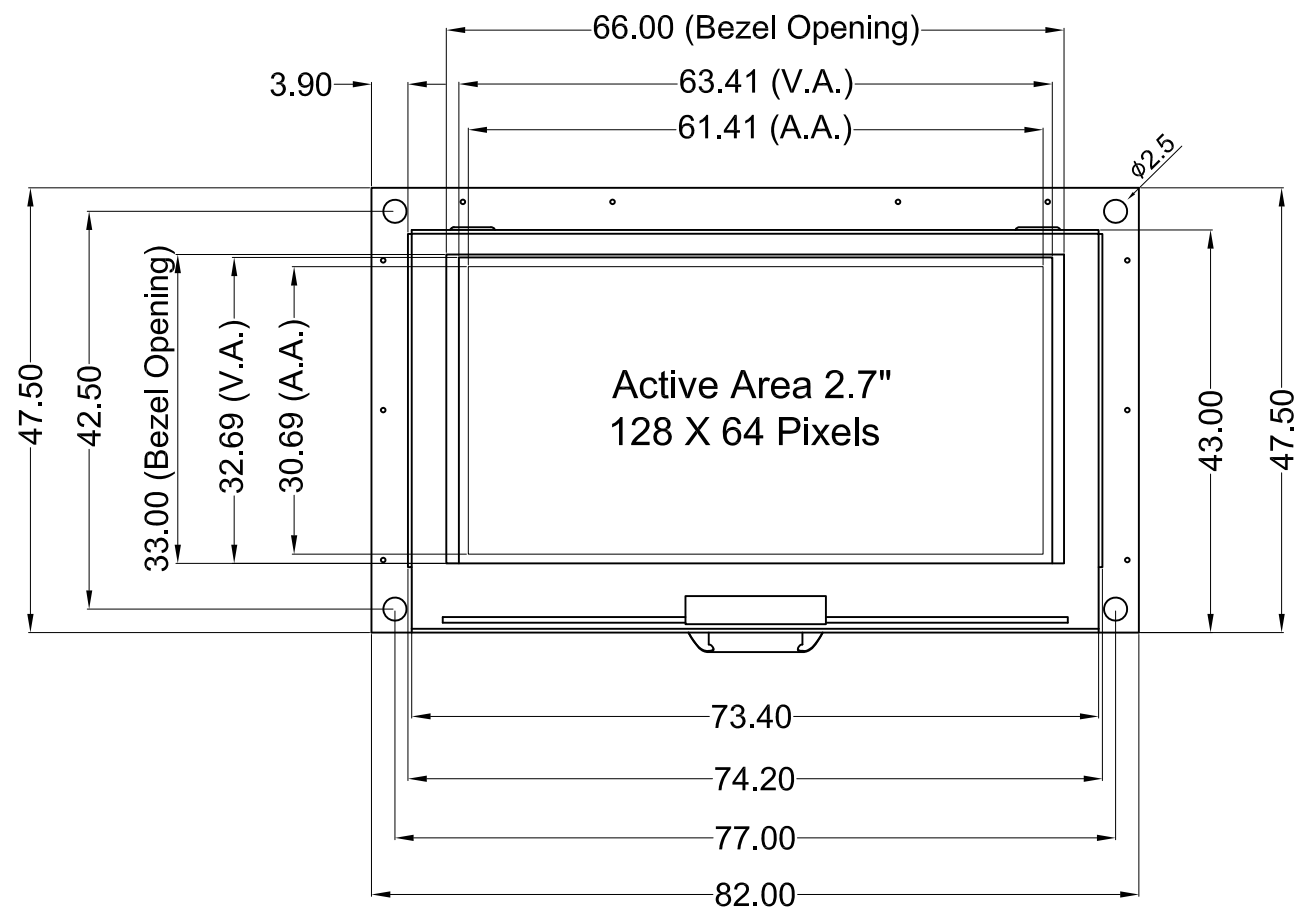
- **Support Forum:** <https://support.newhavendisplay.com/hc/en-us/community/topics>
- **GitHub:** <https://github.com/newhavendisplay>
- **Example Code:** <https://support.newhavendisplay.com/hc/en-us/categories/4409527834135-Example-Code/>
- **Knowledge Center:** https://www.newhavendisplay.com/knowledge_center.html
- **Quality Center:** 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 |
|----------|------------|--|------------|
| - | 06/02/2017 | Initial Release | ML |
| 1 | 7/25/2017 | Update Storage Temperature range | ML |
| 2 | 03/31/2020 | Brightness Updated, Updated Interface Information | SB |
| 3 | 05/12/2020 | Included Additional Dimensions on Mechanical Drawing | AS |
| 4 | 02/04/2021 | Bezel Redesign; Updated 2D Mechanical Drawing | AS |
| 5 | 02/26/2021 | Rectified error in MPU Pin Assignment Summary | AS |
| 6 | 11/22/2022 | Mechanical Drawing Updated | KL |
| 7 | 08/17/2023 | Minimum Supply Voltage Updated from 2.8V to 3.0V | KL |

Mechanical Drawing



| Pin No. | Symbol |
|---------|--------------|
| 1 | Vss |
| 2 | Vdd |
| 3 | NC (BC_VDD) |
| 4 | D/C |
| 5 | R/W |
| 6 | E |
| 7 | DB0 |
| 8 | DB1 |
| 9 | DB2 |
| 10 | DB3 |
| 11 | DB4 |
| 12 | DB5 |
| 13 | DB6 |
| 14 | DB7 |
| 15 | N.C. (Vcc) |
| 16 | /RES |
| 17 | /CS |
| 18 | /SHDN (N.C.) |
| 19 | BS1 |
| 20 | BS0 |

Product Description: 2.7" 128x64 Graphic OLED

1. Driver IC: SSD1322
2. Interface: 8-bit 6800/8080 Parallel, 3/4-Wire SPI
3. Power Requirement: 3.3V OLED
4. Optical Features: Yellow Color, Anti-Glare, Full View

| | | |
|---|--|---------------------------|
| Standard Tolerance: (Unless otherwise specified) Linear: ±0.3mm | | |
| | Drawing/Part Number: NHD-2.7-12864WDY3-M | Revision: - |
| Unless otherwise specified: • Dimensions are in Millimeters • Third Angle Projection | Drawn By: K. Lewis | Approved By: K. Lewis |
| | Drawn Date: 08/17/2023 | Approved Date: 08/17/2023 |
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Pin Description

Parallel Interface:

| Pin No. | Symbol | External Connection | Function Description |
|---------|-----------------------------|---------------------|---|
| 1 | V _{SS} | Power Supply | Ground |
| 2 | V _{DD} | Power Supply | Supply Voltage for OLED module |
| 3 | NC (BC_V _{DD}) | - | No Connect by default. Can be configured to power the boost converter independently. (refer to On-Board Jumper Options section) |
| 4 | D/C | MPU | Data/Command select signal, D/C=0: Command; D/C=1: Data |
| 5 | R/W /WR | MPU | 6800 mode: Read/Write select signal, R/W=1: Read, R/W=0: Write 8080 mode: Active LOW Write signal |
| 6 | E /RD | MPU | 6800 mode: Operation Enable signal. Falling edge triggered. 8080 mode: Active LOW Read signal |
| 7-14 | DB0 – DB7 | MPU | 8-bit bi-directional Data Bus |
| 15 | NC (V _{CC}) | - | No Connect by default. Can be configured to power V _{CC} independently. (refer to On-Board Jumper Options section) |
| 16 | /RES | MPU | Active LOW Reset signal |
| 17 | /CS | MPU | Active LOW Chip Select signal |
| 18 | /SHDN | MPU | Active LOW Shutdown signal for boost converter (internally pulled HIGH). |
| 19 | BS1 | MPU | MPU Interface select signal |
| 20 | BS0 | MPU | MPU Interface select signal |

Serial Interface:

| Pin No. | Symbol | External Connection | Function Description |
|---------|-----------------------------|---------------------|---|
| 1 | V _{SS} | Power Supply | Ground |
| 2 | V _{DD} | Power Supply | Supply Voltage for OLED module |
| 3 | NC (BC_V _{DD}) | - | No Connect by default. Can be configured to power the boost converter independently. (refer to On-Board Jumper Options section) |
| 4 | D/C | MPU | Data/Command select signal, D/C=0: Command; D/C=1: Data Tie LOW for 3-wire SPI |
| 5-6 | V _{SS} | Power Supply | Ground |
| 7 | SCLK | MPU | Serial Clock signal |
| 8 | SDIN | MPU | Serial Data Input signal |
| 9 | NC | - | No Connect |
| 10-14 | V _{SS} | Power Supply | Ground |
| 15 | NC (V _{CC}) | - | No Connect by default. Can be configured to power V _{CC} independently. (refer to On-Board Jumper Options section) |
| 16 | /RES | MPU | Active LOW Reset signal |
| 17 | /CS | MPU | Active LOW Chip Select signal |
| 18 | /SHDN | MPU | Active LOW Shutdown signal for boost converter (internally pulled HIGH). |
| 19 | BS1 | MPU | MPU Interface select signal |
| 20 | BS0 | MPU | MPU Interface select signal |

Interface Selection

MPU Interface Pin Selections

| Pin No. | 6800 Parallel 8-bit interface | 8080 Parallel 8-bit interface | 3-wire Serial Interface | 4-wire Serial Interface |
|---------|-------------------------------|-------------------------------|-------------------------|-------------------------|
| BS1 | 1 | 1 | 0 | 0 |
| BS0 | 1 | 0 | 1 | 0 |

MPU Interface Pin Assignment Summary

| Bus Interface | Data/Command Interface | | | | | | | | Control Signals | | | | |
|---------------|------------------------|----|----|----|----|----|------|------|-----------------|-----|-----|---------|------|
| | D7 | D6 | D5 | D4 | D3 | D2 | D1 | D0 | E | R/W | /CS | D/C | /RES |
| 8-bit 6800 | D[7:0] | | | | | | | | E | R/W | /CS | D/C | /RES |
| 8-bit 8080 | D[7:0] | | | | | | | | /RD | /WR | /CS | D/C | /RES |
| 3-wire SPI | Tie LOW | | | | | NC | SDIN | SCLK | Tie LOW | | /CS | Tie LOW | /RES |
| 4-wire SPI | Tie LOW | | | | | NC | SDIN | SCLK | Tie LOW | | /CS | D/C | /RES |

On-Board Jumper Options

Default Jumper Setting

| R4 | R5 | R7 | Description |
|--------------|------|------|---|
| Close | Open | Open | OLED controller + Boost converter + OLED panel are powered from V _{DD} (pin #2). This allows the full module to be powered by a single low-voltage supply. |

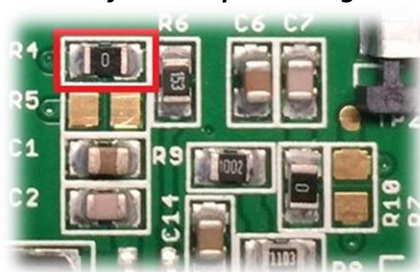
Jumper Option #1 - Independent Supply Voltage for Boost Converter (BC_VDD)

| R4 | R5 | R7 | Description |
|------|--------------|------|--|
| Open | Close | Open | Boost converter + OLED panel are powered from BC_V _{DD} (pin #3). OLED controller is still powered from V _{DD} (pin #2). This allows for increased efficiency through the boost converter by allowing a higher supply voltage at its input, BC_V _{DD} (pin #3). |

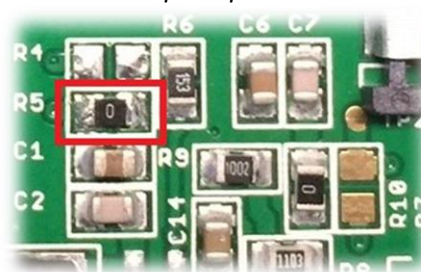
Jumper Option #2 – External Supply Voltage for OLED Panel (VCC)

| R4 | R5 | R7 | Description |
|------|------|--------------|---|
| Open | Open | Close | OLED panel is powered from V _{CC} (pin #15) – boost converter is not used. OLED controller is still powered from V _{DD} (pin #2). This allows for maximum module efficiency, and drastically reduced total current consumption. |

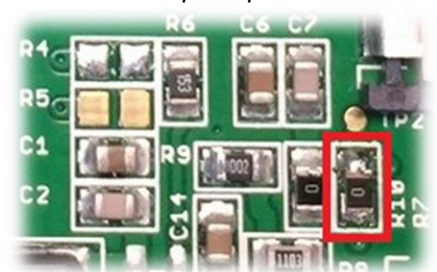
Default Jumper Setting



Jumper Option #1



Jumper Option #2



For detailed electrical information on each jumper option, please see the Electrical Characteristics table below.

Electrical Characteristics

| Item | Symbol | Condition | Min. | Typ. | Max. | Unit |
|------------------------------------|-----------------------|--------------------------|-----------------------|------------|-----------------------|-----------|
| Operating Temperature Range | T _{OP} | Absolute Max | -40 | - | +85 | °C |
| Storage Temperature Range | T _{ST} | Absolute Max | -40 | - | +85 | °C |
| Default Jumper Setting | | | | | | |
| Supply Voltage for Module | V_{DD} | - | 3.0 | 3.3 | 3.5 | V |
| Supply Current for Module | I_{DD} | VDD=3.3V, 100% ON | - | 330 | 360 | mA |
| Jumper Option #1 | | | | | | |
| Supply Voltage for Module | V _{DD} | - | 3.0 | 3.3 | 3.5 | V |
| Supply Current for Module | I _{DD} | VDD=3.3V | - | 180 | 295 | μA |
| Supply Voltage for Boost Converter | BC_V _{DD} | - | 3.0 | 5.0 | 12 | V |
| Supply Current for Boost Converter | I _{DD_BC} | BC_VDD=5.0V, 100% ON | - | 200 | 215 | mA |
| Supply Current for Boost Converter | I _{DD_BC} | BC_VDD=12.0V, 100% ON | - | 80 | 90 | mA |
| Jumper Option #2 | | | | | | |
| Supply Voltage for Module | V _{DD} | - | 3.0 | 3.3 | 3.5 | V |
| Supply Current for Module | I _{DD} | VDD=3.3V | - | 180 | 300 | μA |
| Supply Voltage for OLED Panel | V _{CC} | - | 14.5 | 15 | 15.5 | V |
| Supply Current for OLED Panel | I _{CC} | VCC=15V, 100% ON | - | 60 | 70 | mA |
| Sleep Mode Current | I _{DD_SLEEP} | - | - | 25 | 120 | μA |
| "H" Level input | V _{IH} | - | 0.8 * V _{DD} | - | V _{DD} | V |
| "L" Level input | V _{IL} | - | V _{SS} | - | 0.2 * V _{DD} | V |
| "H" Level output | V _{OH} | - | 0.9 * V _{DD} | - | V _{DD} | V |
| "L" Level output | V _{OL} | - | V _{SS} | - | 0.1 * V _{DD} | V |

Note: The electrical characteristics shown above for Jumper Option #1 and Jumper Option #2 apply only when the on-board jumpers are configured accordingly. By default, only Default Jumper Setting supply voltage and current (in bold) need to be considered. For details, see On-Board Jumper Options section on previous page.

Optical Characteristics

| Item | Symbol | Condition | Min. | Typ. | Max. | Unit |
|------------------------|----------------|--|-----------|------|------|-------------------|
| Optimal Viewing Angles | Top | - | - | 85 | - | ° |
| | Bottom | | - | 85 | - | ° |
| | Left | | - | 85 | - | ° |
| | Right | | - | 85 | - | ° |
| Contrast Ratio | C _r | - | >10,000:1 | - | - | - |
| Response Time | Rise | T _R | - | 10 | - | μs |
| | Fall | T _F | - | 10 | - | μs |
| Brightness | L _V | 50% Checkerboard | 60 | 80 | - | cd/m ² |
| Lifetime | - | T _{OP} =25°C, L _V =80cd/m ² | 100,000 | - | - | hrs |
| | - | T _{OP} =25°C, L _V =60cd/m ² | 150,000 | - | - | hrs |

Note: Lifetime at typical temperature is based on accelerated high-temperature operation. Lifetime is tested at average 50% pixels on and is rated as Hours until **Half-Brightness**. To extend the life of the display, lower values may be used for the contrast setting registers – see below table of commands for details.

Controller Information

Built-in SSD1322 Controller: <https://support.newhavendisplay.com/hc/en-us/articles/4414477846679-SSD1322>



Table of Commands

| Instruction | Code | | | | | | | | | | Description | RESET value |
|------------------------|------|---------------|----------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|--|----------------------------|
| | D/C | HEX | DB7 | DB6 | DB5 | DB4 | DB3 | DB2 | DB1 | DB0 | | |
| Enable Grayscale Table | 0 | 00 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | Enable the Grayscale table settings. (see command 0xB8) | |
| Set Column Address | 0 | 15 | 0 | 0 | 0 | 1 | 0 | 1 | 0 | 1 | Set column start and end address A[6:0]: Column start address. Range: 0-119d B[6:0]: Column end address. Range: 0-119d | 0 119d |
| | 1 | A[6:0] | * | A6 | A5 | A4 | A3 | A2 | A1 | A0 | | |
| | 1 | B[6:0] | * | B6 | B5 | B4 | B3 | B2 | B1 | B0 | | |
| Write RAM Command | 0 | 5C | 0 | 1 | 0 | 1 | 1 | 1 | 0 | 0 | Enable MCU to write Data into RAM | |
| Read RAM Command | 0 | 5D | 0 | 1 | 0 | 1 | 1 | 1 | 0 | 1 | Enable MCU to read Data from RAM | |
| Set Row Address | 0 | 75 | 0 | 1 | 1 | 1 | 0 | 1 | 0 | 1 | Set row start and end address A[6:0]: Row start address. Range: 0-127d B[6:0]: Row end address. Range: 0-127d | 0 127d |
| | 1 | A[6:0] | * | A6 | A5 | A4 | A3 | A2 | A1 | A0 | | |
| | 1 | B[6:0] | * | B6 | B5 | B4 | B3 | B2 | B1 | B0 | | |
| Set Re-map | 0 | A0 | 1 | 0 | 1 | 0 | 0 | 0 | 0 | 0 | A[0] = 0; Horizontal Address Increment A[0] = 1; Vertical Address Increment A[1] = 0; Disable Column Address remap A[1] = 1; Enable Column Address remap A[2] = 0; Disable Nibble remap A[2] = 1; Enable Nibble remap A[4] = 0; Scan from COM0 to COM[N-1] A[4] = 1; Scan from COM[N-1] to COM0 A[5] = 0; Disable COM split Odd/Even A[5] = 1; Enable COM split Odd/Even B[4] = 0; Disable Dual COM mode B[4] = 1; Enable Dual COM mode Note: A[5] must be 0 if B[4] is 1. | 0 0 0 0 0 0 |
| | 1 | A[5:0] | 0 | 0 | A5 | A4 | 0 | A2 | A1 | A0 | | |
| | 1 | B[4] | * | * | 0 | B4 | 0 | 0 | 0 | 1 | | |
| Set Display Start Line | 0 | A1 | 1 | 0 | 1 | 0 | 0 | 0 | 0 | 1 | Set display RAM display start line register from 0-127. | 0 |
| | 1 | A[6:0] | * | A6 | A5 | A4 | A3 | A2 | A1 | A0 | | |
| Set Display Offset | 0 | A2 | 1 | 0 | 1 | 0 | 0 | 0 | 1 | 0 | Set vertical shift by COM from 0~127. | 0 |
| | 1 | A[6:0] | * | A6 | A5 | A4 | A3 | A2 | A1 | A0 | | |
| Display Mode | 0 | A4~A7 | 1 | 0 | 1 | 0 | 0 | X2 | X1 | X0 | 0xA4 = Entire display OFF 0xA5 = Entire display ON, all pixels Grayscale level 15 0xA6 = Normal display 0xA7 = Inverse display | 0xA6 |
| Enable Partial Display | 0 | A8 | 1 | 0 | 1 | 0 | 1 | 0 | 0 | 0 | Turns ON partial mode. A[6:0] = Address of start row B[6:0] = Address of end row (B[6:0] > A[6:0]) | |
| | 1 | A[6:0] | 0 | A6 | A5 | A4 | A3 | A2 | A1 | A0 | | |
| | 1 | B[6:0] | 0 | B6 | B5 | B4 | B3 | B2 | B1 | B0 | | |
| Exit Partial Display | 0 | A9 | 1 | 0 | 1 | 0 | 1 | 0 | 0 | 1 | Exit Partial Display mode | |
| Function Selection | 0 | AB | 1 | 0 | 1 | 0 | 1 | 0 | 1 | 1 | A[0] = 0; External VDD A[0] = 1; Internal VDD regulator | 1 |
| | 1 | A[0] | 0 | 0 | 0 | 0 | 0 | 0 | 0 | A0 | | |

| | | | | | | | | | | | | |
|--|--------|----------------------------|----------------|----------------|----------------|----------------|----------------|----------------|----------------|----------------|--|------|
| Select Default Linear Gray Scale Table | 0 1 | B9 | 1 0 | 0 1 | 1 1 | 1 1 | 1 1 | 0 0 | 0 1 | 1 1 | Sets Linear Grayscale table GSO pulse width = 0 GSO pulse width = 0 GSO pulse width = 8 GSO pulse width = 16 . . . GSO pulse width = 104 GSO pulse width = 112 | |
| Set Pre-charge Voltage | 0 1 | BB A[4:0] | 1 * | 0 * | 1 * | 1 A4 | 1 A3 | 0 A2 | 1 A1 | 1 A0 | Set precharge voltage level. A[4:0] = 0x00; 0.20*VCC . . A[4:0] = 0x3E; 0.60*VCC | 0x17 |
| Set VCOMH Voltage | 0 1 | BE A[3:0] | 1 * | 0 * | 1 * | 1 * | 1 A3 | 1 A2 | 1 A1 | 0 A0 | Sets the VCOMH voltage level A[3:0] = 0x00; 0.72*VCC . . A[3:0] = 0x04; 0.8*VCC . . A[3:0] = 0x07; 0.86*VCC | 0x04 |
| Set Contrast Control | 0 1 | C1 A[7:0] | 1 A7 | 1 A6 | 0 A5 | 0 A4 | 0 A3 | 0 A2 | 0 A1 | 1 A0 | Double byte command to select 1 out of 256 contrast steps. Contrast increases as the value increases. | 0x7F |
| Master Contrast Control | 0 1 | C7 A[3:0] | 1 * | 1 * | 0 * | 0 * | 0 A3 | 1 A2 | 1 A1 | 1 A0 | A[3:0] = 0x00; Reduce output for all colors to 1/16 A[3:0] = 0x01; Reduce output for all colors to 2/16 . . A[3:0] = 0x0E; Reduce output for all colors to 15/16 A[3:0] = 0x0F; no change | 0x0f |
| Set Multiplex Ratio | 0 1 | CA A[6:0] | 1 * | 1 A6 | 0 A5 | 0 A4 | 1 A3 | 0 A2 | 1 A1 | 0 A0 | Set MUX ratio to N+1 MUX N=A[6:0]; from 16MUX to 128MUX (0 to 14 are invalid) | 127d |
| Set Command Lock | 0 1 | FD A[2] | 1 0 | 1 0 | 1 0 | 1 1 | 1 0 | 1 A2 | 0 1 | 1 0 | A[2] = 0; Unlock OLED to enable commands A[2] = 1; Lock OLED from entering commands | 0x12 |

For detailed instruction information, view full SSD1322 datasheet here (pages 32-47):

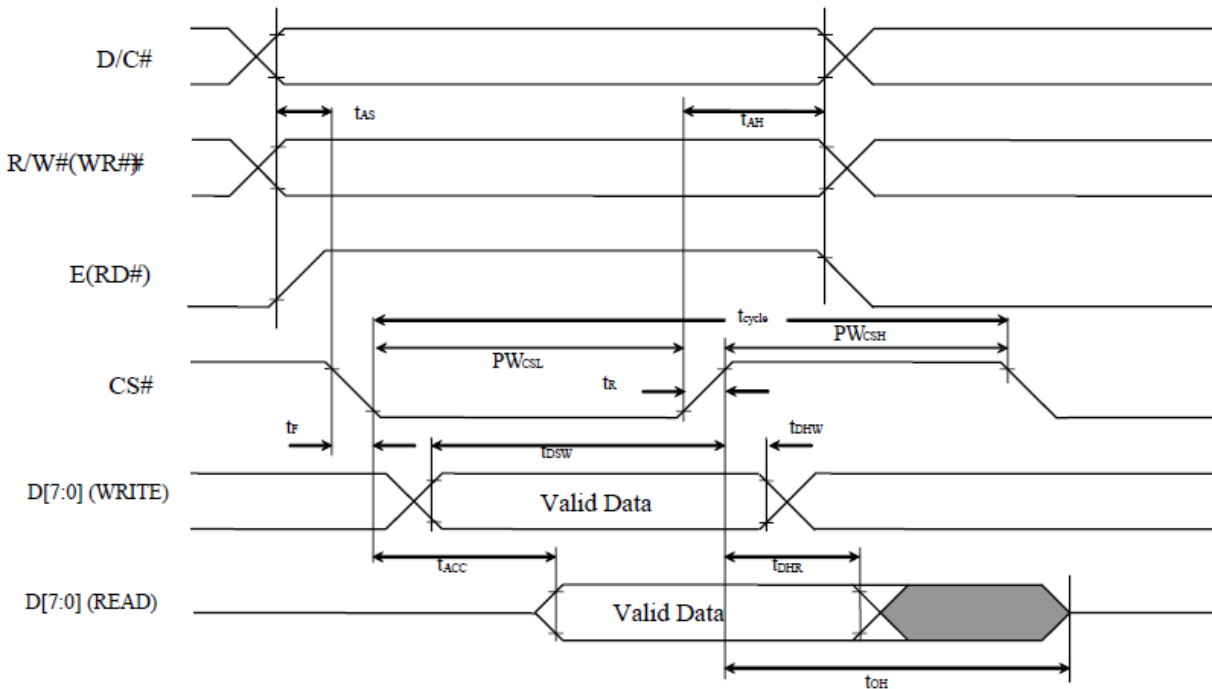
http://www.newhavendisplay.com/app_notes/SSD1322.pdf

Timing Characteristics-OLED

6800-MPU Parallel Interface

($V_{DDIO} - V_{SS} = 2.1V - V_{CI}$, $V_{CI} - V_{SS} = 2.4V - 3.5V$, $T_A = 25^\circ C$)

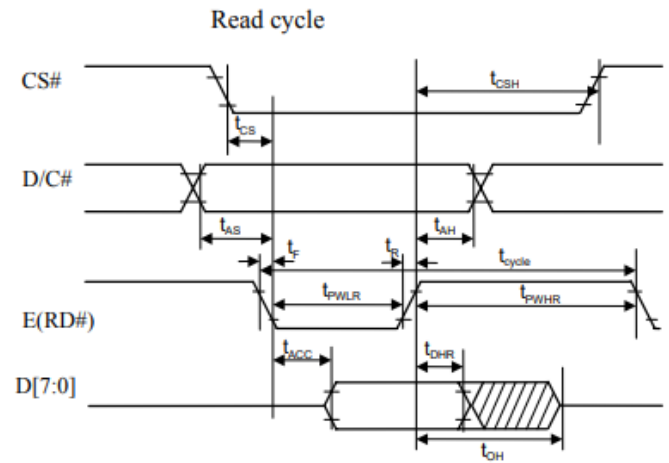
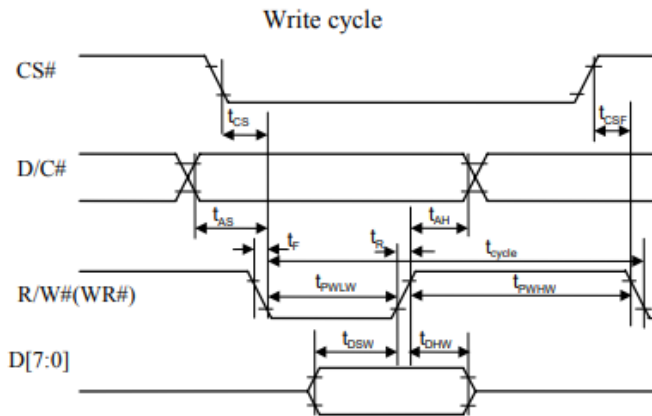
| Symbol | Parameter | Min | Typ | Max | Unit |
|-------------|--------------------------------------|-----|-----|-----|------|
| t_{CYCLE} | Clock Cycle Time (read) | 300 | - | - | ns |
| | Clock Cycle Time (write) | 100 | - | - | ns |
| t_{AS} | Address Setup Time | 15 | - | - | ns |
| t_{AH} | Address Hold Time | 0 | - | - | ns |
| t_{DSW} | Write Data Setup Time | 40 | - | - | ns |
| t_{DHW} | Write Data Hold Time | 10 | - | - | ns |
| t_{DHR} | Read Data Hold Time | 20 | - | - | ns |
| t_{OH} | Output Disable Time | - | - | 70 | ns |
| t_{ACC} | Access Time | - | - | 140 | ns |
| PW_{CSL} | Chip Select Low Pulse Width (read) | 150 | - | - | ns |
| | Chip Select Low Pulse Width (write) | 60 | - | - | ns |
| PW_{CSH} | Chip Select High Pulse Width (read) | 60 | - | - | ns |
| | Chip Select High Pulse Width (write) | 60 | - | - | ns |
| t_R | Rise Time | - | - | 15 | ns |
| t_F | Fall Time | - | - | 15 | ns |



8080-MPU Parallel Interface

($V_{DDIO} - V_{SS} = 2.1V - V_{CI}$, $V_{CI} - V_{SS} = 2.4V - 3.5V$, $T_A = 25^\circ C$)

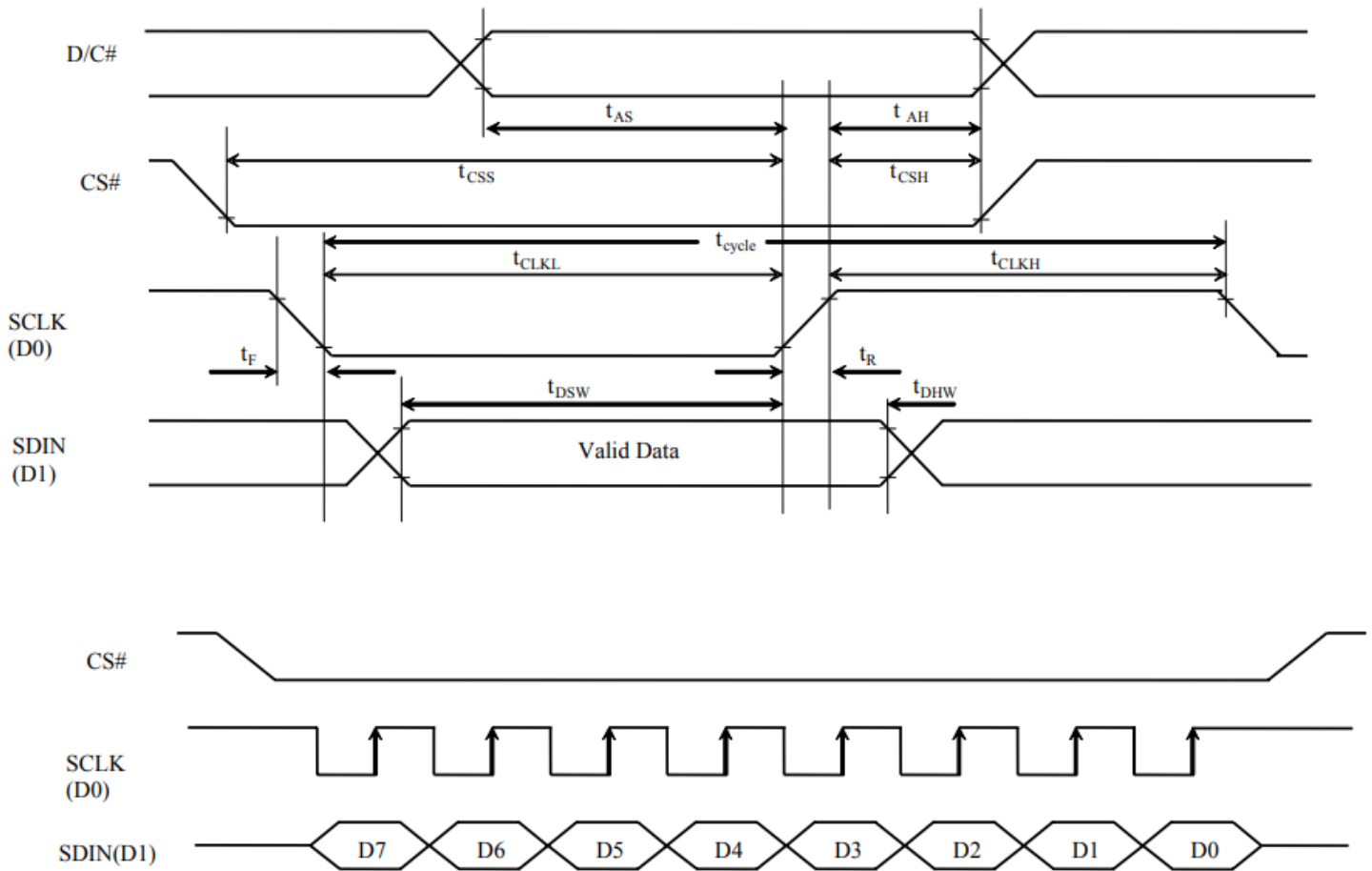
| Symbol | Parameter | Min | Typ | Max | Unit |
|-------------|---|------------|-----|-----|------|
| t_{CYCLE} | Clock Cycle Time (read) Clock Cycle Time (write) | 300 100 | - | - | ns |
| t_{AS} | Address Setup Time | 10 | - | - | ns |
| t_{AH} | Address Hold Time | 0 | - | - | ns |
| t_{DSW} | Write Data Setup Time | 40 | - | - | ns |
| t_{DHW} | Write Data Hold Time | 10 | - | - | ns |
| t_{DHR} | Read Data Hold Time | 20 | - | - | ns |
| t_{OH} | Output Disable Time | - | - | 70 | ns |
| t_{ACC} | Access Time | - | - | 140 | ns |
| $t_{PWL R}$ | Read Low Time | 150 | - | - | ns |
| $t_{PWL W}$ | Write Low Time | 60 | - | - | ns |
| $t_{PWH R}$ | Read High Time | 60 | - | - | ns |
| $t_{PWH W}$ | Write High Time | 60 | - | - | ns |
| t_R | Rise Time | - | - | 15 | ns |
| t_F | Fall Time | - | - | 15 | ns |
| t_{CS} | Chip select setup time | 0 | - | - | ns |
| t_{CSH} | Chip select hold time to read signal | 0 | - | - | ns |
| t_{CSF} | Chip select hold time | 20 | - | - | ns |



Serial Interface (4-wire)

($V_{DDIO} - V_{SS} = 2.1V - V_{Cl}$, $V_{Cl} - V_{SS} = 2.4V - 3.5V$, $T_A = 25^\circ C$)

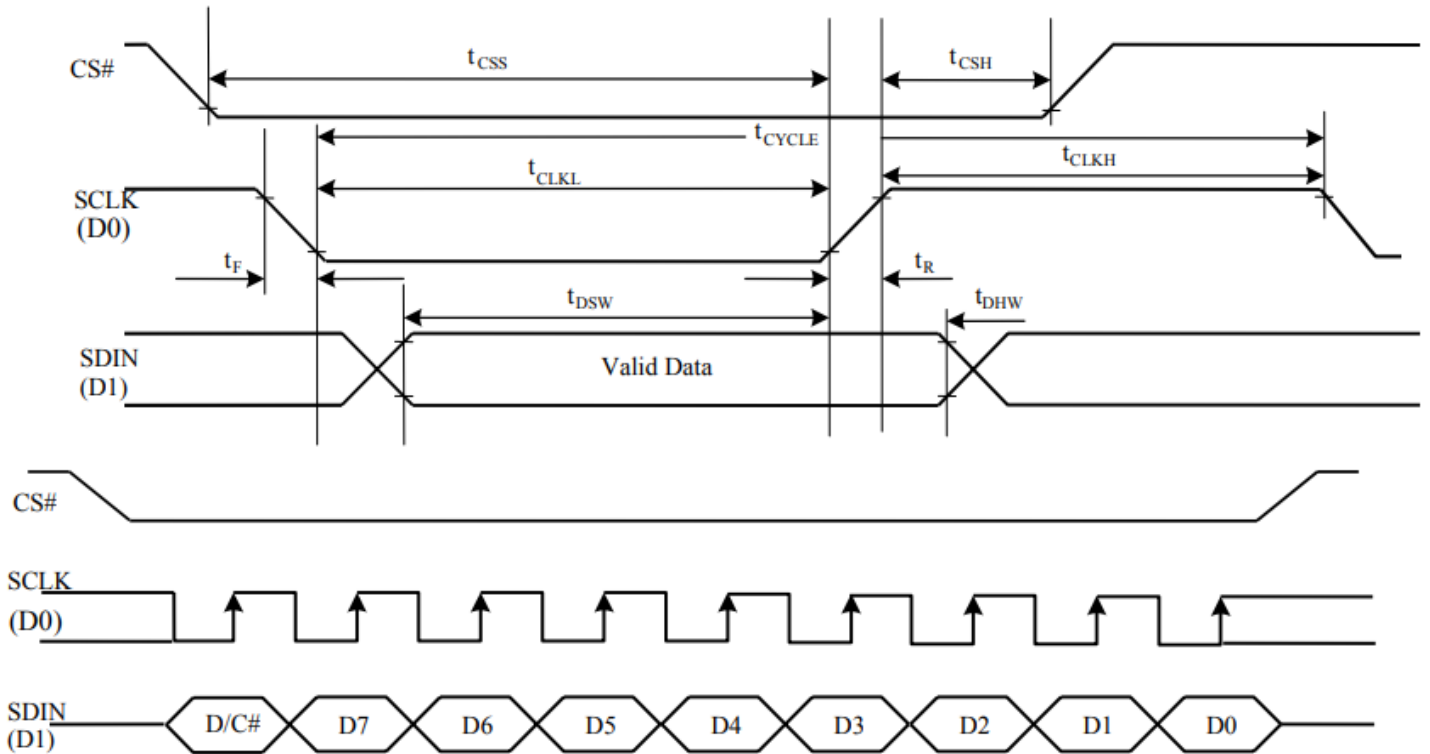
| Symbol | Parameter | Min | Typ | Max | Unit |
|-------------|------------------------|-----|-----|-----|------|
| t_{cycle} | Clock Cycle Time | 300 | - | - | ns |
| t_{AS} | Address Setup Time | 15 | - | - | ns |
| t_{AH} | Address Hold Time | 25 | - | - | ns |
| t_{CSS} | Chip Select Setup Time | 20 | - | - | ns |
| t_{CSH} | Chip Select Hold Time | 10 | - | - | ns |
| t_{DSW} | Write Data Setup Time | 15 | - | - | ns |
| t_{DHW} | Write Data Hold Time | 20 | - | - | ns |
| t_{CLKL} | Clock Low Time | 25 | - | - | ns |
| t_{CLKH} | Clock High Time | 40 | - | - | ns |
| t_R | Rise Time | - | - | 15 | ns |
| t_F | Fall Time | - | - | 15 | ns |



Serial Interface (3-wire)

($V_{DDIO} - V_{SS} = 2.1V - V_{Cl}$, $V_{Cl} - V_{SS} = 2.4V - 3.5V$, $T_A = 25^\circ C$)

| Symbol | Parameter | Min | Typ | Max | Unit |
|-------------|------------------------|-----|-----|-----|------|
| t_{cycle} | Clock Cycle Time | 300 | - | - | ns |
| t_{CSS} | Chip Select Setup Time | 20 | - | - | ns |
| t_{CSH} | Chip Select Hold Time | 25 | - | - | ns |
| t_{DSW} | Write Data Setup Time | 15 | - | - | ns |
| t_{DHW} | Write Data Hold Time | 20 | - | - | ns |
| t_{CLKL} | Clock Low Time | 25 | - | - | ns |
| t_{CLKH} | Clock High Time | 25 | - | - | ns |
| t_R | Rise Time | - | - | 15 | ns |
| t_F | Fall Time | - | - | 15 | ns |



Example Software Routines

Code to initialize OLED:

```
void NHD12864WDY3_Init(void){
    digitalWrite(RESPIN, LOW);           //pull /RES (pin #16) low
    delayUS(200);                       //keep /RES low for minimum 200µs
    digitalWrite(RESPIN, HIGH);         //pull /RES high
    delayUS(200);                       //wait minimum 200µs before sending commands
    writeCommand(0xAE);                 //display OFF
    writeCommand(0xB3);                 //set CLK div. & OSC freq.
    writeData(0x91);
    writeCommand(0xCA);                 //set MUX ratio
    writeData(0x3F);
    writeCommand(0xA2);                 //set offset
    writeData(0x00);
    writeCommand(0xAB);                 //function selection
    writeData(0x01);
    writeCommand(0xA0);                 //set re-map
    writeData(0x16);
    writeData(0x11);
    writeCommand(0xC7);                 //master contrast current
    writeData(0x0F);
    writeCommand(0xC1);                 //set contrast current
    writeData(0x9F);
    writeCommand(0xB1);                 //set phase length
    writeData(0xF2);
    writeCommand(0xBB);                 //set pre-charge voltage
    writeData(0x1F);
    writeCommand(0xB4);                 //set VSL
    writeData(0xA0);
    writeData(0xFD);
    writeCommand(0xBE);                 //set VCOMH
    writeData(0x04);
    writeCommand(0xA6);                 //set display mode
    writeCommand(0xAF);                 //display ON
}
```

Quality Information

| Test Item | Content of Test | Test Condition | Note |
|-------------------------------------|---|---|------|
| High Temperature storage | Endurance test applying the high storage temperature for a long time. | +85°C, 240hrs | 2 |
| Low Temperature storage | Endurance test applying the low storage temperature for a long time. | -40°C, 240hrs | 1,2 |
| High Temperature Operation | Endurance test applying the electric stress (voltage & current) and the high thermal stress for a long time. | +85°C, 240hrs | 2 |
| Low Temperature Operation | Endurance test applying the electric stress (voltage & current) and the low thermal stress for a long time. | -40°C, 240hrs | 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, 240hrs | 1,2 |
| Thermal Shock resistance | Endurance test applying the electric stress (voltage & current) during a cycle of low and high thermal stress. | -40°C, 30min -> +25°C, 5min -> +85°C, 30min = 1 cycle 100 cycles | |
| Vibration test | Endurance test applying vibration to simulate transportation and use. | 10-22Hz, 15mm amplitude. 22-500Hz, 1.5G 30min in each of 3 directions X, Y, Z | 3 |
| Atmospheric Pressure Test | Test the endurance of the display by applying atmospheric pressure to simulate transportation by air. | 115mbar, 40hrs | 3 |
| Static electricity test | Endurance test applying electric static discharge. | Air: ±8KV; 300Ω, 150pF | |
| | | Contact: ±4KV; 300Ω, 150pF | |

Note 1: No condensation to be observed.

Note 2: Conducted after 2 hours of storage at 25°C, 0%RH.

Note 3: Test performed on product itself, not inside a container.