

**Product Specification**

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# NHD-2.7-12864WDY3

## Graphic OLED Display Module

<b>NHD-</b>	Newhaven Display
<b>2.7-</b>	2.7" Diagonal Size
<b>12864-</b>	128x64 Pixel Resolution
<b>WD-</b>	Model
<b>Y-</b>	Emitting Color: Yellow
<b>3-</b>	3.3V Power Supply

## Table of Contents

Document Revision History.....	2
Mechanical Drawing.....	3
Pin Description.....	4
Interface Selection.....	5
On-Board Jumper Options.....	5
Electrical Characteristics.....	6
Optical Characteristics.....	7
Controller Information.....	7
Table of Commands.....	8
Timing Characteristics – OLED.....	11
Example Software Routines.....	15
Quality Information.....	16

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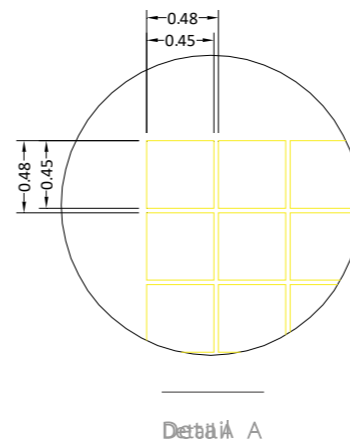
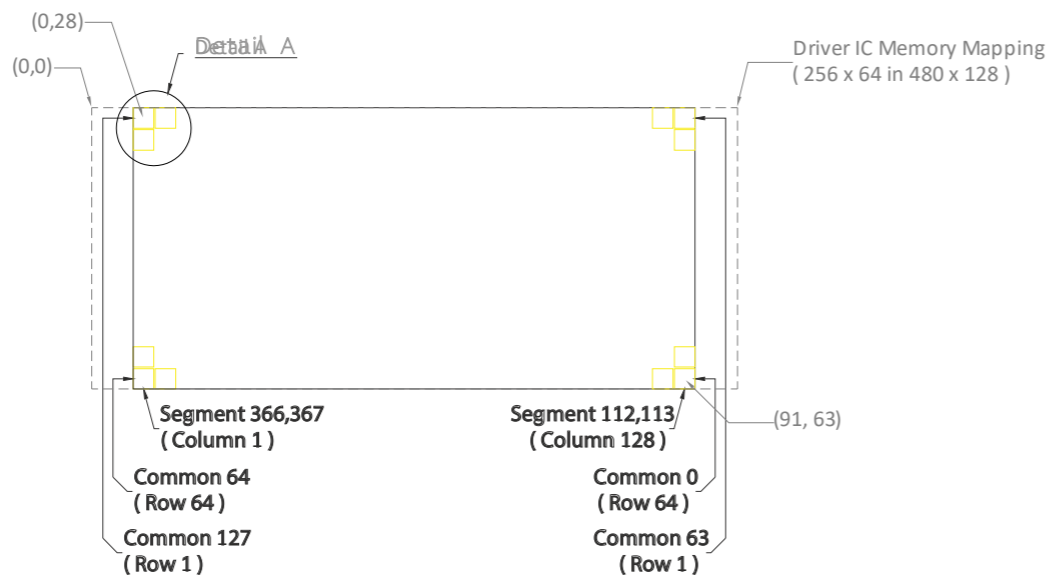
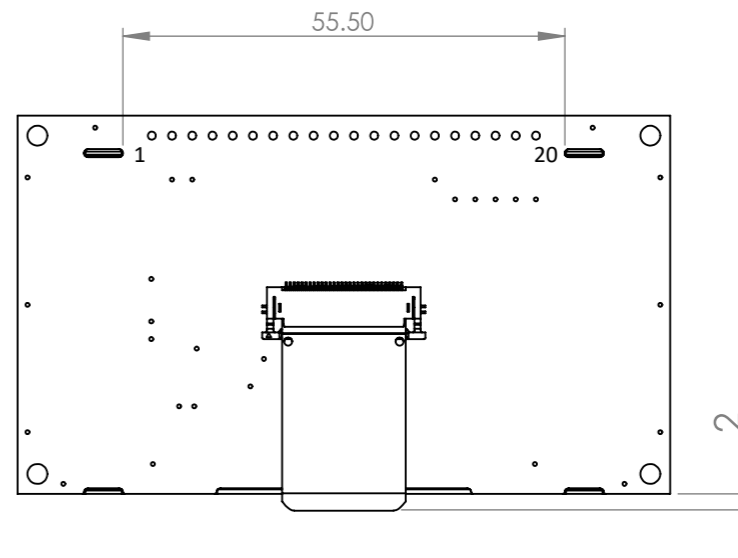
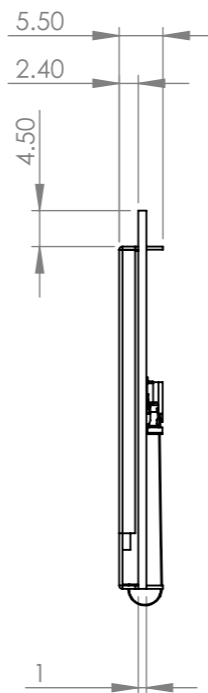
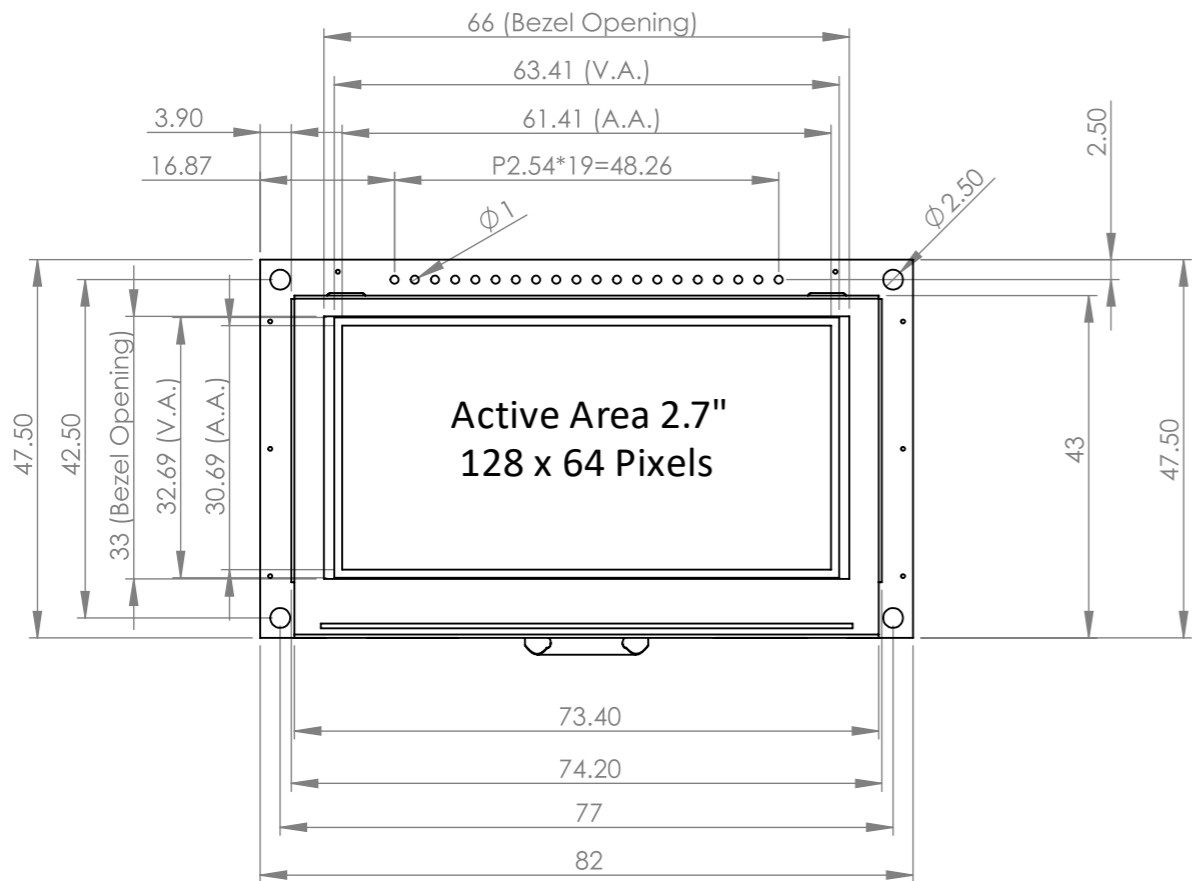
## Additional Resources

- **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
-	06/02/2017	Initial Release	ML
1	07/25/2017	Update Storage Temperature Range	ML
2	06/21/2019	Updated 6800 Mode Control and Added Timing Diagrams	TM
3	03/30/2020	Updated Brightness	SB
4	05/12/2020	Included Additional Dimensions on Mechanical Drawing	AS
5	02/04/2021	Bezel Redesign; Updated 2D Mechanical Drawing	AS
6	02/26/2020	Rectified Error in MPU Pin Assignment Summary	AS
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
5. Recommended Pin Header: 1x20pin 2.54mm pitch

<b>Standard Tolerance:</b> (Unless otherwise specified)  Linear: ±0.3mm		
	Drawing/Part Number: <b>NHD-2.7-12864WDY3</b>	Revision: -
<b>Unless otherwise specified:</b> • 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 <sub>SS</sub>	Power Supply	Ground
2	V <sub>DD</sub>	Power Supply	Supply Voltage for OLED module
3	NC (BC_V <sub>DD</sub> )	-	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	<b>6800 mode:</b> Read/Write select signal, R/W=1: Read, R/W=0: Write <b>8080 mode:</b> Active LOW Write signal
6	E /RD	MPU	<b>6800 mode:</b> Operation Enable signal. Falling edge triggered. <b>8080 mode:</b> Active LOW Read signal
7-14	DB0 – DB7	MPU	8-bit bi-directional Data Bus
15	NC (V <sub>CC</sub> )	-	No Connect by default. Can be configured to power V <sub>CC</sub> 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 <sub>SS</sub>	Power Supply	Ground
2	V <sub>DD</sub>	Power Supply	Supply Voltage for OLED module
3	NC (BC_V <sub>DD</sub> )	-	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 <sub>SS</sub>	Power Supply	Ground
7	SCLK	MPU	Serial Clock signal
8	SDIN	MPU	Serial Data Input signal
9	NC	-	No Connect
10-14	V <sub>SS</sub>	Power Supply	Ground
15	NC (V <sub>CC</sub> )	-	No Connect by default. Can be configured to power V <sub>CC</sub> 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 Name	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
<b>Close</b>	Open	Open	OLED controller + Boost converter + OLED panel are powered from V <sub>DD</sub> (pin #2). This allows the full module to be powered by a single low-voltage supply.

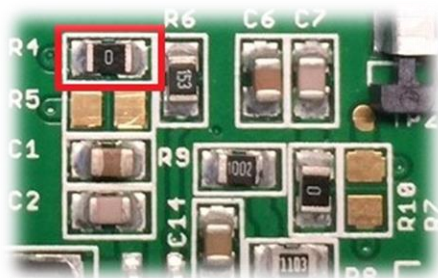
## Jumper Option #1 - Independent Supply Voltage for Boost Converter (BC\_VDD)

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

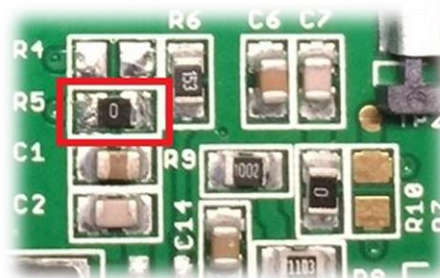
## Jumper Option #2 – External Supply Voltage for OLED Panel (VCC)

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

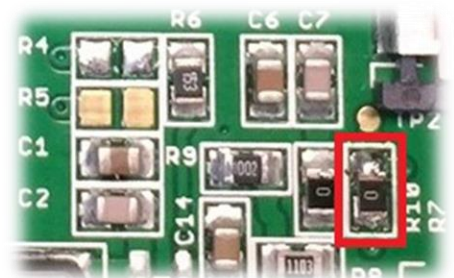
**Default Jumper Setting**



**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 <sub>OP</sub>	Absolute Max	-40	-	+85	°C
Storage Temperature Range	T <sub>ST</sub>	Absolute Max	-40	-	+85	°C
<b>Default Jumper Setting</b>						
<b>Supply Voltage for Module</b>	<b>V<sub>DD</sub></b>	-	<b>3.0</b>	<b>3.3</b>	<b>3.5</b>	<b>V</b>
<b>Supply Current for Module</b>	<b>I<sub>DD</sub></b>	<b>V<sub>DD</sub>=3.3V, 100% ON</b>	-	<b>330</b>	<b>360</b>	<b>mA</b>
Jumper Option #1						
Supply Voltage for Module	V <sub>DD</sub>	-	3.0	3.3	3.5	V
Supply Current for Module	I <sub>DD</sub>	V <sub>DD</sub> =3.3V	-	180	295	μA
Supply Voltage for Boost Converter	BC_V <sub>DD</sub>	-	3.0	5.0	12	V
Supply Current for Boost Converter	I <sub>DD_BC</sub>	BC_V <sub>DD</sub> =5.0V, 100% ON	-	190	205	mA
Supply Current for Boost Converter	I <sub>DD_BC</sub>	BC_V <sub>DD</sub> =12.0V, 100% ON	-	70	80	mA
Jumper Option #2						
Supply Voltage for Module	V <sub>DD</sub>	-	3.0	3.3	3.5	V
Supply Current for Module	I <sub>DD</sub>	V <sub>DD</sub> =3.3V	-	180	300	μA
Supply Voltage for OLED Panel	V <sub>CC</sub>	-	14.5	15	15.5	V
Supply Current for OLED Panel	I <sub>CC</sub>	V <sub>CC</sub> =15V, 100% ON	-	60	70	mA
Sleep Mode Current	I <sub>DD_SLEEP</sub>	-	-	25	120	μA
"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>	-	V <sub>SS</sub>	-	0.2 * V <sub>DD</sub>	V
"H" Level output	V <sub>OH</sub>	-	0.9 * V <sub>DD</sub>	-	V <sub>DD</sub>	V
"L" Level output	V <sub>OL</sub>	-	V <sub>SS</sub>	-	0.1 * V <sub>DD</sub>	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	$\phi Y+$	-	-	85	-	°
	Bottom	$\phi Y-$		-	85	-	°
	Left	$\theta X-$		-	85	-	°
	Right	$\theta X+$		-	85	-	°
Contrast Ratio		$C_R$	-	>10,000:1	-	-	-
Response Time	Rise	$T_R$	-	-	10	-	$\mu s$
	Fall	$T_F$	-	-	10	-	$\mu s$
Brightness		$L_V$	50% Checkerboard	60	80	-	$cd/m^2$
Lifetime		-	$T_{OP}=25^\circ C, L_V=80cd/m^2$	100,000	-	-	hrs
		-	$T_{OP}=25^\circ C, L_V=60cd/m^2$	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	<b>00</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>0</b>	Enable the Grayscale table settings. (see command 0xB8)	
Set Column Address	0	<b>15</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>1</b>	<b>0</b>	<b>1</b>	<b>0</b>	<b>1</b>	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	<b>A[6:0]</b>	*	<b>A6</b>	<b>A5</b>	<b>A4</b>	<b>A3</b>	<b>A2</b>	<b>A1</b>	<b>A0</b>		
	1	<b>B[6:0]</b>	*	<b>B6</b>	<b>B5</b>	<b>B4</b>	<b>B3</b>	<b>B2</b>	<b>B1</b>	<b>B0</b>		
Write RAM Command	0	<b>5C</b>	<b>0</b>	<b>1</b>	<b>0</b>	<b>1</b>	<b>1</b>	<b>1</b>	<b>0</b>	<b>0</b>	Enable MCU to write Data into RAM	
Read RAM Command	0	<b>5D</b>	<b>0</b>	<b>1</b>	<b>0</b>	<b>1</b>	<b>1</b>	<b>1</b>	<b>0</b>	<b>1</b>	Enable MCU to read Data from RAM	
Set Row Address	0	<b>75</b>	<b>0</b>	<b>1</b>	<b>1</b>	<b>1</b>	<b>0</b>	<b>1</b>	<b>0</b>	<b>1</b>	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	<b>A[6:0]</b>	*	<b>A6</b>	<b>A5</b>	<b>A4</b>	<b>A3</b>	<b>A2</b>	<b>A1</b>	<b>A0</b>		
	1	<b>B[6:0]</b>	*	<b>B6</b>	<b>B5</b>	<b>B4</b>	<b>B3</b>	<b>B2</b>	<b>B1</b>	<b>B0</b>		
Set Re-map	0	<b>A0</b>	<b>1</b>	<b>0</b>	<b>1</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>0</b>	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	<b>A[5:0]</b>	<b>0</b>	<b>0</b>	<b>A5</b>	<b>A4</b>	<b>0</b>	<b>A2</b>	<b>A1</b>	<b>A0</b>		
	1	<b>B[4]</b>	*	*	<b>0</b>	<b>B4</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>1</b>		
Set Display Start Line	0	<b>A1</b>	<b>1</b>	<b>0</b>	<b>1</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>1</b>	Set display RAM display start line register from 0-127.	0
	1	<b>A[6:0]</b>	*	<b>A6</b>	<b>A5</b>	<b>A4</b>	<b>A3</b>	<b>A2</b>	<b>A1</b>	<b>A0</b>		
Set Display Offset	0	<b>A2</b>	<b>1</b>	<b>0</b>	<b>1</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>1</b>	<b>0</b>	Set vertical shift by COM from 0~127.	0
	1	<b>A[6:0]</b>	*	<b>A6</b>	<b>A5</b>	<b>A4</b>	<b>A3</b>	<b>A2</b>	<b>A1</b>	<b>A0</b>		
Display Mode	0	<b>A4~A7</b>	<b>1</b>	<b>0</b>	<b>1</b>	<b>0</b>	<b>0</b>	<b>X2</b>	<b>X1</b>	<b>X0</b>	0xA4 = Entire display OFF 0xA5 = Entire display ON, all pixels Grayscale level 15 0xA6 = Normal display 0xA7 = Inverse display	0xA6
Enable Partial Display	0	<b>A8</b>	<b>1</b>	<b>0</b>	<b>1</b>	<b>0</b>	<b>1</b>	<b>0</b>	<b>0</b>	<b>0</b>	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	<b>A[6:0]</b>	<b>0</b>	<b>A6</b>	<b>A5</b>	<b>A4</b>	<b>A3</b>	<b>A2</b>	<b>A1</b>	<b>A0</b>		
	1	<b>B[6:0]</b>	<b>0</b>	<b>B6</b>	<b>B5</b>	<b>B4</b>	<b>B3</b>	<b>B2</b>	<b>B1</b>	<b>B0</b>		
Exit Partial Display	0	<b>A9</b>	<b>1</b>	<b>0</b>	<b>1</b>	<b>0</b>	<b>1</b>	<b>0</b>	<b>0</b>	<b>1</b>	Exit Partial Display mode	
Function Selection	0	<b>AB</b>	<b>1</b>	<b>0</b>	<b>1</b>	<b>0</b>	<b>1</b>	<b>0</b>	<b>1</b>	<b>1</b>	A[0] = 0; External VDD A[0] = 1; Internal VDD regulator	1



											The setting must be followed by command 0x00.		
Select Default Linear Gray Scale Table	0 1	<b>B9</b>	<b>1</b>	<b>0</b>	<b>1</b>	<b>1</b>	<b>1</b>	<b>1</b>	<b>0</b>	<b>0</b>	<b>1</b>	Sets Linear Grayscale table GS0 pulse width = 0 GS0 pulse width = 0 GS0 pulse width = 8 GS0 pulse width = 16 . . . GS0 pulse width = 104 GS0 pulse width = 112	
Set Pre-charge Voltage	0 1	<b>BB</b> <b>A[4:0]</b>	<b>1</b> *	<b>0</b> *	<b>1</b> *	<b>1</b> <b>A4</b>	<b>1</b> <b>A3</b>	<b>0</b> <b>A2</b>	<b>1</b> <b>A1</b>	<b>1</b> <b>A0</b>	Set precharge voltage level. A[4:0] = 0x00; 0.20*VCC . . A[4:0] = 0x3E; 0.60*VCC	0x17	
Set VCOMH Voltage	0 1	<b>BE</b> <b>A[3:0]</b>	<b>1</b> *	<b>0</b> *	<b>1</b> *	<b>1</b> *	<b>1</b> <b>A3</b>	<b>1</b> <b>A2</b>	<b>1</b> <b>A1</b>	<b>0</b> <b>A0</b>	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	<b>C1</b> <b>A[7:0]</b>	<b>1</b> <b>A7</b>	<b>1</b> <b>A6</b>	<b>0</b> <b>A5</b>	<b>0</b> <b>A4</b>	<b>0</b> <b>A3</b>	<b>0</b> <b>A2</b>	<b>0</b> <b>A1</b>	<b>1</b> <b>A0</b>	Double byte command to select 1 out of 256 contrast steps. Contrast increases as the value increases.	0x7F	
Master Contrast Control	0 1	<b>C7</b> <b>A[3:0]</b>	<b>1</b> *	<b>1</b> *	<b>0</b> *	<b>0</b> *	<b>0</b> <b>A3</b>	<b>1</b> <b>A2</b>	<b>1</b> <b>A1</b>	<b>1</b> <b>A0</b>	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	<b>CA</b> <b>A[6:0]</b>	<b>1</b> *	<b>1</b> <b>A6</b>	<b>0</b> <b>A5</b>	<b>0</b> <b>A4</b>	<b>1</b> <b>A3</b>	<b>0</b> <b>A2</b>	<b>1</b> <b>A1</b>	<b>0</b> <b>A0</b>	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	<b>FD</b> <b>A[2]</b>	<b>1</b> <b>0</b>	<b>1</b> <b>0</b>	<b>1</b> <b>0</b>	<b>1</b> <b>1</b>	<b>1</b> <b>0</b>	<b>1</b> <b>A2</b>	<b>0</b> <b>1</b>	<b>1</b> <b>0</b>	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):

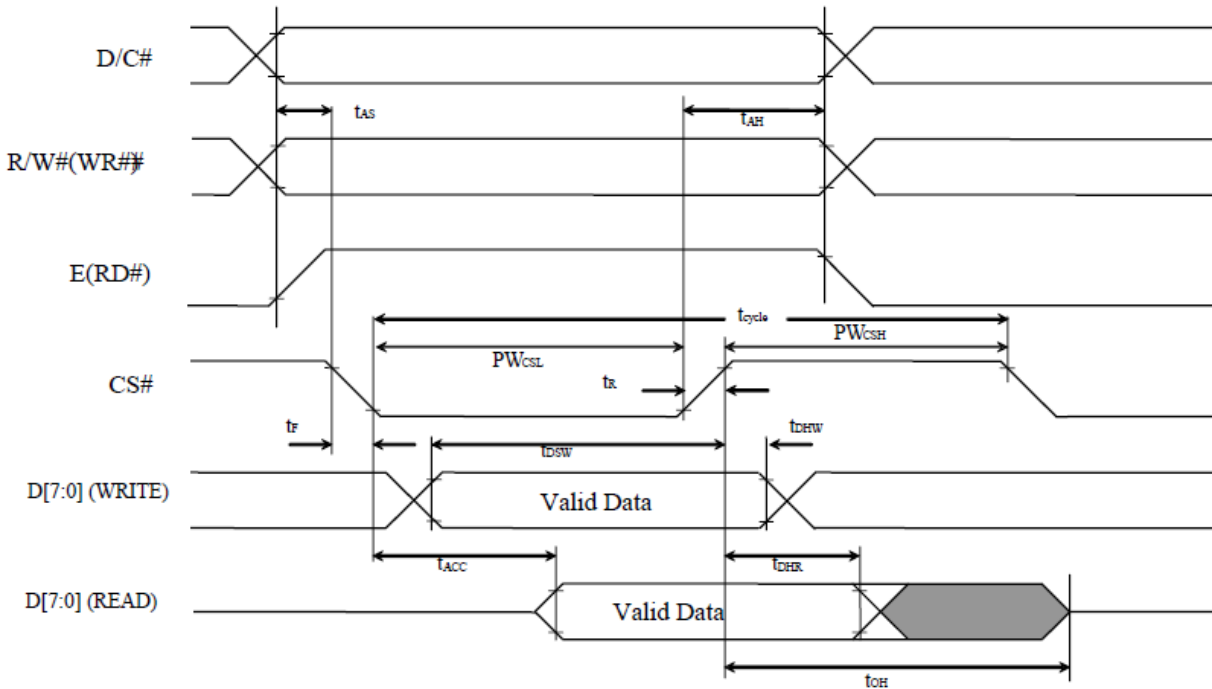
[http://www.newhavendisplay.com/app\\_notes/SSD1322.pdf](http://www.newhavendisplay.com/app_notes/SSD1322.pdf)

# Timing Characteristics – OLED

## 6800-MPU Parallel Interface

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

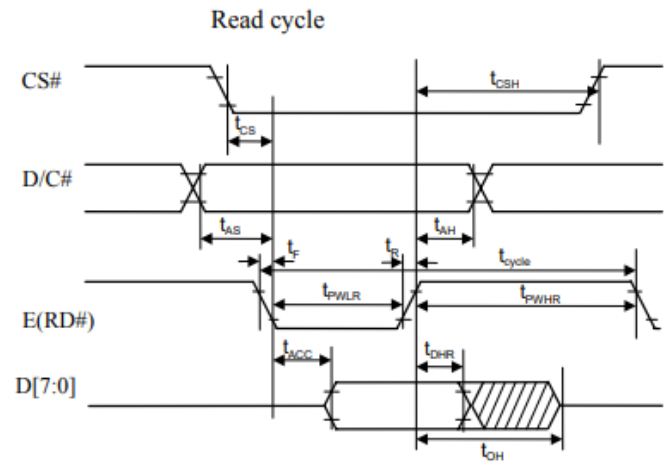
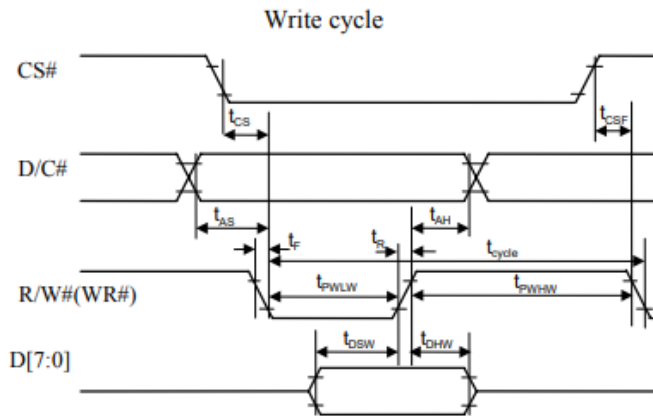
Symbol	Parameter	Min	Typ	Max	Unit
$t_{CYCLE}$	Clock Cycle Time (read)	300	-	-	ns
	Clock Cycle Time (write)	100	-	-	ns
$t_{AS}$	Address Setup Time	15	-	-	ns
$t_{AH}$	Address Hold Time	0	-	-	ns
$t_{DSW}$	Write Data Setup Time	40	-	-	ns
$t_{DHW}$	Write Data Hold Time	10	-	-	ns
$t_{DHR}$	Read Data Hold Time	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

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

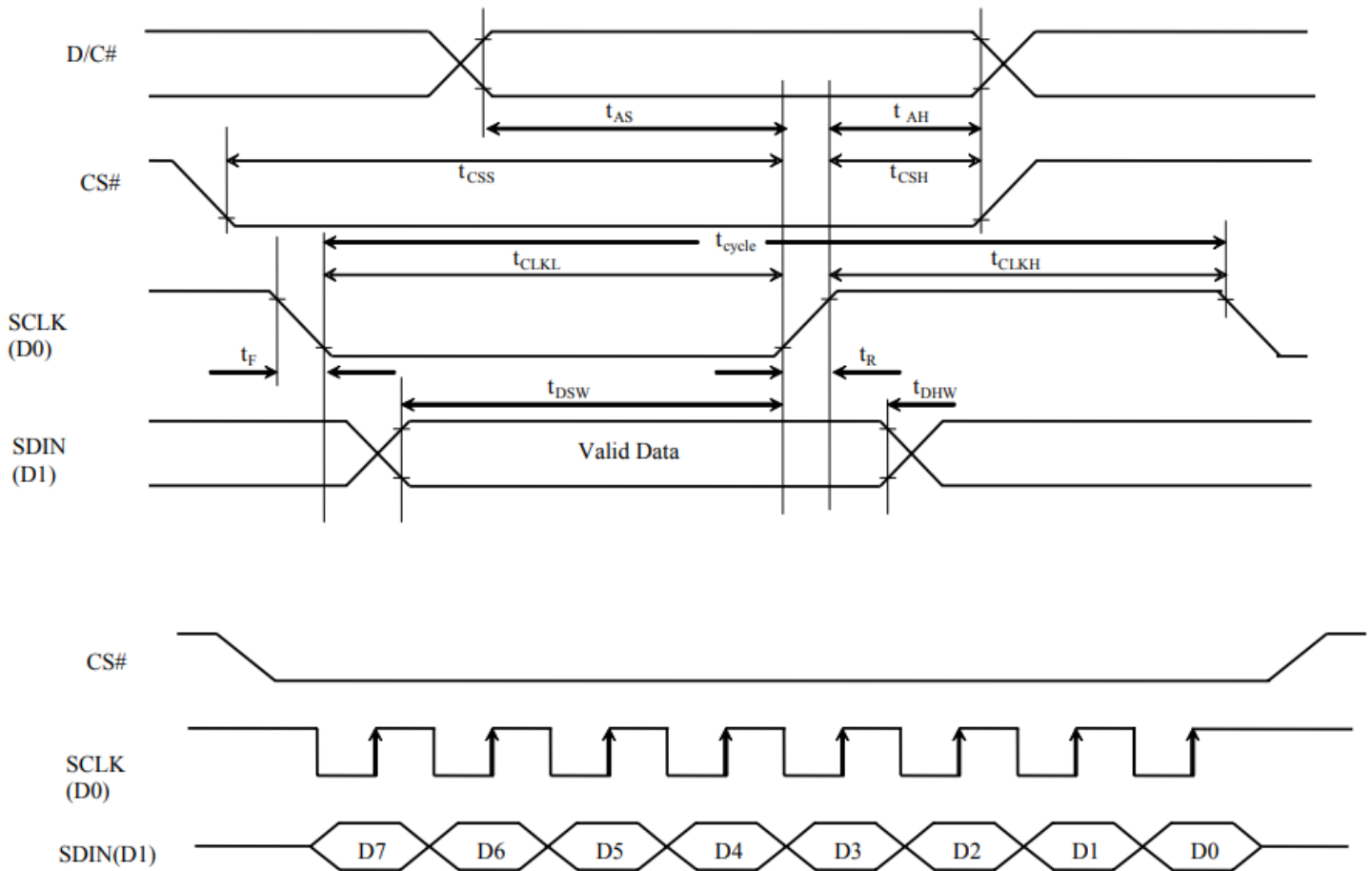
Symbol	Parameter	Min	Typ	Max	Unit
$t_{CYCLE}$	Clock Cycle Time (read)	300	-	-	ns
	Clock Cycle Time (write)	100	-	-	ns
$t_{AS}$	Address Setup Time	10	-	-	ns
$t_{AH}$	Address Hold Time	0	-	-	ns
$t_{DSW}$	Write Data Setup Time	40	-	-	ns
$t_{DHW}$	Write Data Hold Time	10	-	-	ns
$t_{DHR}$	Read Data Hold Time	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)

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

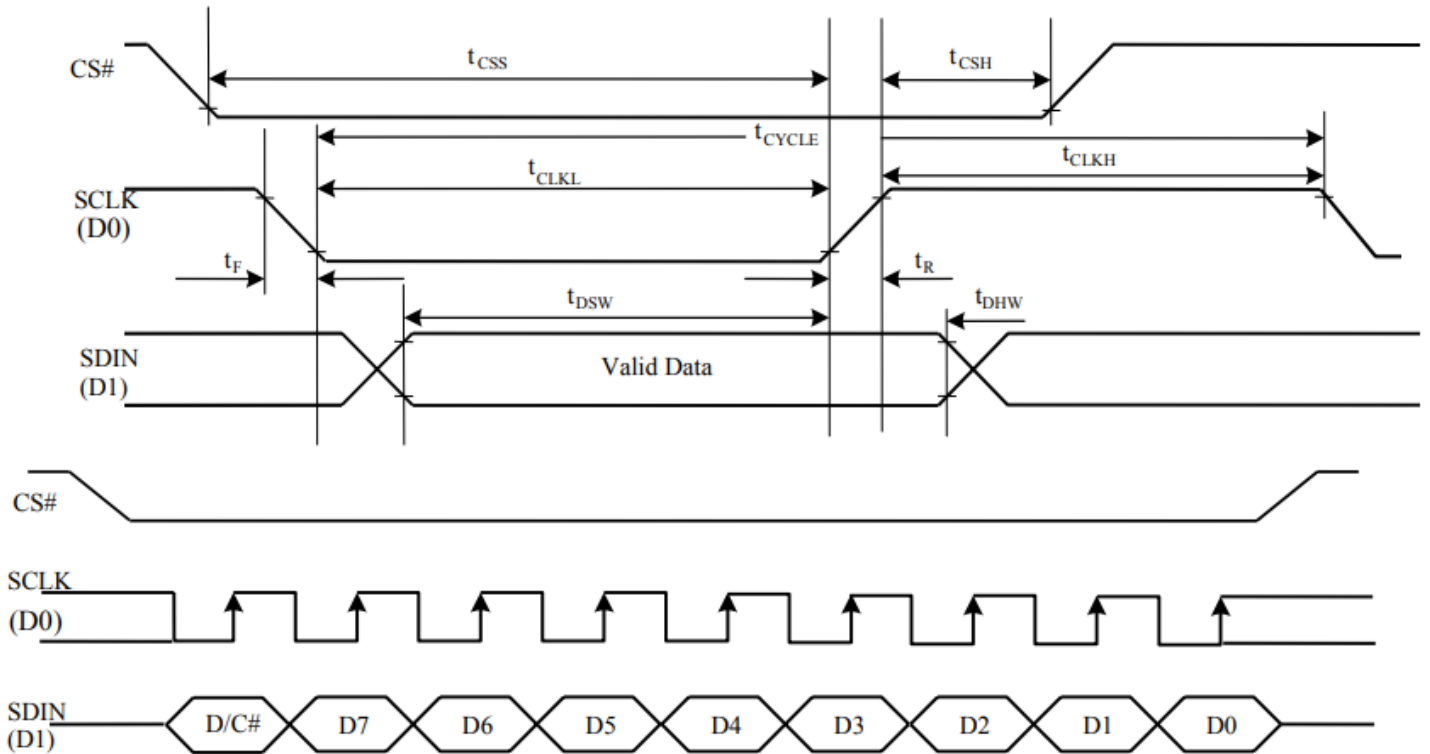
Symbol	Parameter	Min	Typ	Max	Unit
$t_{cycle}$	Clock Cycle Time	300	-	-	ns
$t_{AS}$	Address Setup Time	15	-	-	ns
$t_{AH}$	Address Hold Time	25	-	-	ns
$t_{CSS}$	Chip Select Setup Time	20	-	-	ns
$t_{CSH}$	Chip Select Hold Time	10	-	-	ns
$t_{DSW}$	Write Data Setup Time	15	-	-	ns </td
$t_{DHW}$	Write Data 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
$t_{cyc}$	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.