

NHD-0.95-9664G

Graphic Color OLED Display

NHD-	Newhaven Display
0.95-	0.95" Diagonal Size
9664-	96 x 64 Pixels
G-	OLED Glass

Newhaven Display International, Inc.

2661 Galvin Ct.

Elgin IL, 60124

Ph: 847-844-8795

Fax: 847-844-8796

www.newhavendisplay.com

nhtech@newhavendisplay.com

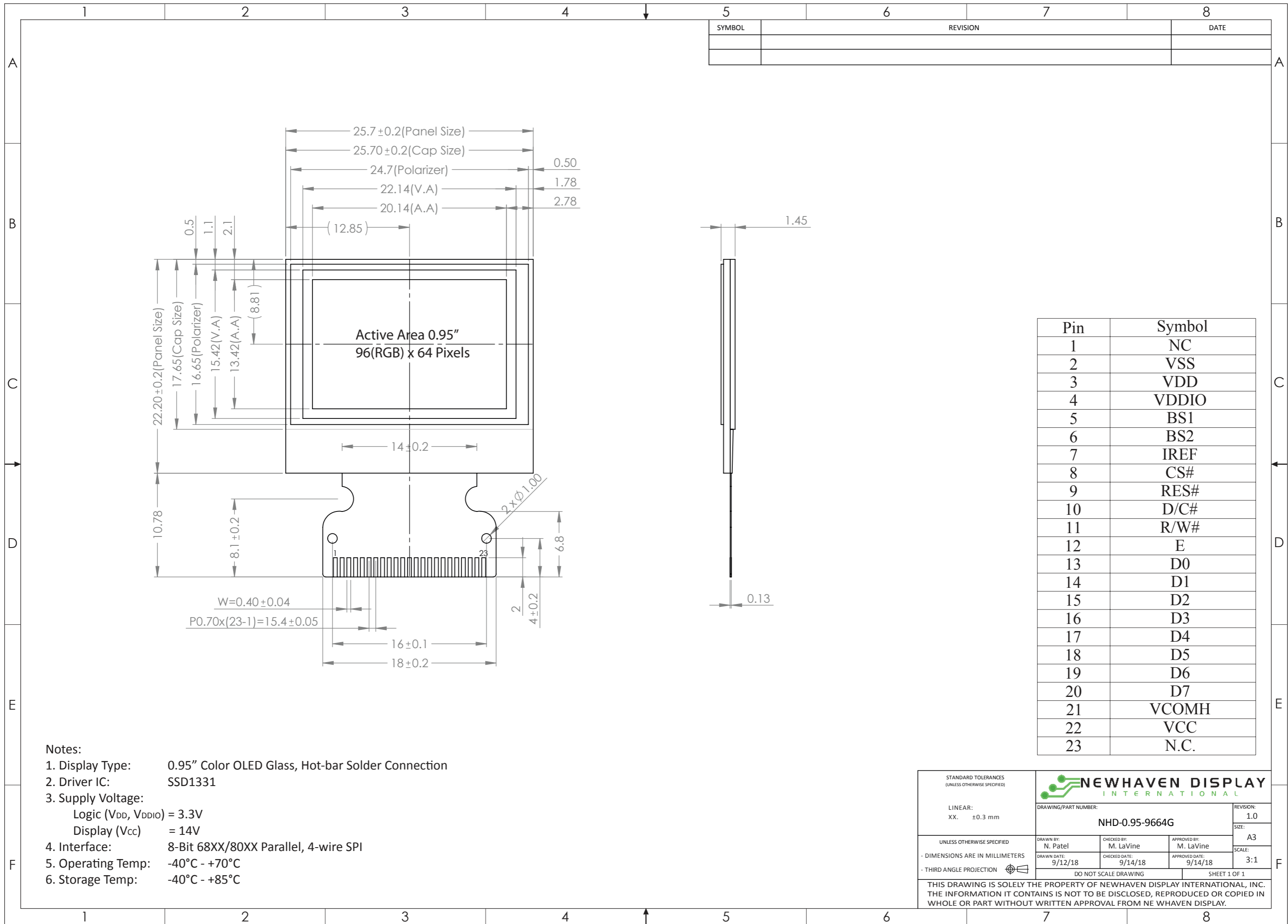
nhsales@newhavendisplay.com

Document Revision History

Revision	Date	Description	Changed by
-	1/21/19	Initial Release	ML

Functions and Features

- 96 x 64 pixel resolution
- Built-in SSD1331 controller
- Serial or Parallel interface
- RoHS compliant



SYMBOL	REVISION	DATE

Pin	Symbol
1	NC
2	VSS
3	VDD
4	VDDIO
5	BS1
6	BS2
7	IREF
8	CS#
9	RES#
10	D/C#
11	R/W#
12	E
13	D0
14	D1
15	D2
16	D3
17	D4
18	D5
19	D6
20	D7
21	VCOMH
22	VCC
23	N.C.

- Notes:
1. Display Type: 0.95" Color OLED Glass, Hot-bar Solder Connection
 2. Driver IC: SSD1331
 3. Supply Voltage:
 - Logic (V_{DD}, V_{DDIO}) = 3.3V
 - Display (V_{CC}) = 14V
 4. Interface: 8-Bit 68XX/80XX Parallel, 4-wire SPI
 5. Operating Temp: -40°C - +70°C
 6. Storage Temp: -40°C - +85°C

STANDARD TOLERANCES (UNLESS OTHERWISE SPECIFIED)				REVISION:	1.0	
				DRAWING/PART NUMBER:	NHD-0.95-9664G	SIZE:
LINEAR: XX. ±0.3 mm	UNLESS OTHERWISE SPECIFIED			DRAWN BY:	N. Patel	
	- DIMENSIONS ARE IN MILLIMETERS			CHECKED BY:	M. LaVine	
	- THIRD ANGLE PROJECTION			APPROVED BY:	M. LaVine	
	DRAWN DATE:	9/12/18	CHECKED DATE:	9/14/18	APPROVED DATE:	9/14/18
	DO NOT SCALE DRAWING				SHEET 1 OF 1	
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Interface Description

Pin No.	Symbol	External Connection	Function Description
1	NC	-	No connect (can be tied to Ground)
2	V _{SS}	Power Supply	Ground
3	V _{DD}	Power Supply	Supply voltage for Logic
4	V _{DDIO}	Power Supply	Supply voltage for I/O
5	BS1	MPU	MPU interface select signal
6	BS2	MPU	MPU interface select signal
7	I _{REF}	Power Supply	Current reference for brightness adjustment
8	CS#	MPU	Active LOW Chip Select signal
9	RES#	MPU	Active LOW Reset signal
10	D/C#	MPU	Data/Command selection. LOW: Command. HIGH: Data
11	R/W# WR#	MPU	6800 mode: Read/Write signal. LOW: Write. HIGH: Read 8080 mode: Active LOW Write signal
12	E RD#	MPU	6800 mode: Enable signal. Falling edge triggered 8080 mode: Active LOW Read signal
13	D0	MPU	Parallel interface: 8-bit bi-directional data bus Serial interface: D0 = Serial Clock signal (SCLK) D1 = Serial Data Input signal (SDIN)
14	D1	MPU	
15	D2	MPU	
16	D3	MPU	
17	D4	MPU	
18	D5	MPU	
19	D6	MPU	
20	D7	MPU	
21	V _{COMH}	Power Supply	Voltage output high level for COM signal
22	V _{CC}	Power Supply	Supply voltage for OLED panel
23	NC	-	No connect

Recommended display connector: n/a (Hot-bar solder directly to PCB)

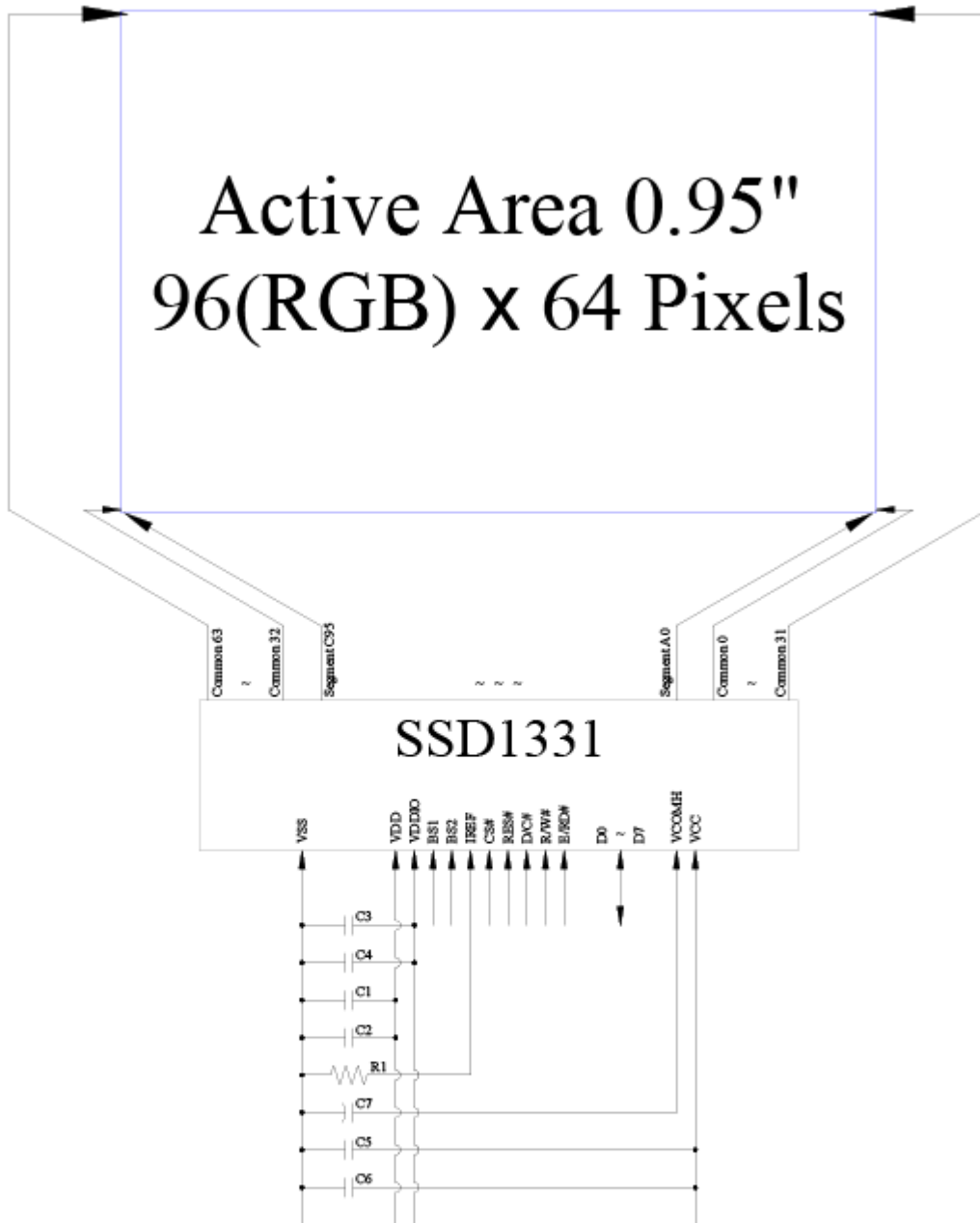
MPU Interface Pin Assignment Summary

Bus Interface	D7	D6	D5	D4	D3	D2	D1	D0	E	R/W	BS1	BS2	/CS	D/C	/RES
8-bit 6800	D[7:0]								RD#	WR#	1	1	/CS	D/C	/RES
8-bit 8080	D[7:0]								E	R/W#	0	1	/CS	D/C	/RES
4-wire SPI	0				NC	SDIN	SCLK	0	0	0	0	/CS	D/C	/RES	

Note:

- “NC” : No Connect
- “1” : VDD
- “0” : VSS

Wiring Diagram



MCU Interface Selection: BS1 and BS2
 Pins connected to MCU interface: CS#, RES#, D/C#, R/W#, E/RD#, and D0~D7

C1, C3, C5: 0.1 μ F
 C2, C4: 4.7 μ F
 C6: 10 μ F
 C7: 4.7 μ F / 25V Tantalum Capacitor
 R1: 1.2M Ω , $R1 = (\text{Voltage at IREF} - \text{VSS}) / \text{IREF}$

Electrical Characteristics

Item	Symbol	Condition	Min.	Typ.	Max.	Unit
Operating Temperature Range	T _{OP}	Absolute Max	-40	-	+70	°C
Storage Temperature Range	T _{ST}	Absolute Max	-40	-	+85	°C
Supply Voltage for Logic	V _{DD}	-	2.4	2.8	3.5	V
Supply Voltage for I/O Pins	V _{DDIO}	-	1.6	2.8	V _{DD}	
Supply Voltage for Display	V _{CC}	-	13.5	14.0	14.5	V
Supply Current for Logic	I _{DD}	V _{DD} = 2.8V; 100% On	-	200	600	μA
Supply Current for Display	I _{CC}	V _{CC} = 14V; 50% On	-	8.0	11.0	mA
		V _{CC} = 14V; 100% On	-	13.5	18.0	mA
Supply Current (Sleep)	I _{SLEEP}	V _{DD} = 2.8V	-	3	15	μA
"H" Level input	V _{IH}	-	0.8 * V _{DDIO}	-	V _{DDIO}	V
"L" Level input	V _{IL}	-	V _{SS}	-	0.2 * V _{DDIO}	V
"H" Level output	V _{OH}	-	0.9 * V _{DDIO}	-	V _{DDIO}	V
"L" Level output	V _{OL}	-	V _{SS}	-	0.1 * V _{DDIO}	V

Optical Characteristics

Item	Symbol	Condition	Min.	Typ.	Max.	Unit
Optimal Viewing Angles	Top		80	-	-	°
	Bottom		80	-	-	°
	Left		80	-	-	°
	Right		80	-	-	°
Contrast Ratio	CR	-	-	>10,000:1	-	
Response Time (rise)	T _R	-	-	10	-	μs
Response Time (fall)	T _F	-	-	10	-	μs
Brightness	L _V	50% Checkerboard	80	100	-	cd/m ²
Lifetime	-	100 cd/m ² , T _{OP} =25°C 50% Checkerboard	10,000	-	-	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**. The Display OFF command can be used to extend the lifetime of the display.

Luminance of active pixels will degrade faster than inactive pixels. Residual (burn-in) images may occur. To avoid this, every pixel should be illuminated uniformly.

Controller information

Built-in SSD1331 controller.

Please download specification at <http://www.newhavendisplay.com/appnotes/datasheets/OLEDs/SSD1331.pdf>

Table of Commands

Fundamental Commands													
D/C#	Hex	D7	D6	D5	D4	D3	D2	D1	D0	Command	Description	Default	
0 0 0	15 A[6:0] B[6:0]	0 *	0 A ₆	0 A ₅	1 A ₄	0 A ₃	1 A ₂	0 A ₁	1 A ₀	Set Column Address	Setup Column start and end address A[6:0] start address from 00d-95d B[6:0] end address from 00d-95d	00d (00h) 95d (5Fh)	
0 0 0	75 A[5:0] B[5:0]	0 *	1 *	1 A ₅	1 A ₄	0 A ₃	1 A ₂	0 A ₁	1 A ₀		Set Row Address	Setup Row start and end address A[5:0] start address from 00d-63d B[5:0] end address from 00d-63d	00d (00h) 63d (3Fh)
0 0	81 A[7:0]	1 A ₇	0 A ₆	0 A ₅	0 A ₄	0 A ₃	0 A ₂	0 A ₁	1 A ₀			Set Contrast for Color "A"	Set contrast for all color "A" segment (Pins:SA0 – SA95) A[7:0] valid range: 00d to 255d
0 0	82 A[7:0]	1 A ₇	0 A ₆	0 A ₅	0 A ₄	0 A ₃	0 A ₂	1 A ₁	0 A ₀	Set Contrast for Color "B"			Set contrast for all color "B" segment (Pins:SB0 – SB95). A[7:0] valid range: 00d to 255d
0 0	83 A[7:0]	1 A ₇	0 A ₆	0 A ₅	0 A ₄	0 A ₃	0 A ₂	1 A ₁	1 A ₀		Set Contrast for Color "C"		Set contrast for all color "C" segment (Pins:SC0 – SC95). A[7:0] valid range: 00d to 255d
0 0	87 A[3:0]	1 0	0 0	0 0	0 0	0 A ₃	1 A ₂	1 A ₁	1 A ₀			Master Current Control	Set master current attenuation factor A[3:0] from 00d to 15d corresponding to 1/16, 2/16... to 16/16 attenuation.

Fundamental Commands																				
D/C#	Hex	D7	D6	D5	D4	D3	D2	D1	D0	Command	Description	Default								
0 0 0 0 0 0	8A A[7:0] 8B A[7:0] 8C A[7:0]	1 A ₇	0 A ₆	0 A ₅	0 A ₄	1 A ₃	0 A ₂	1 A ₁	0 A ₀	Set Second Pre-charge Speed for Color "A", "B" and "C"	<p>A[7:0]: Set Second Pre-charge Speed Ranges: 0000000b to 1111111b, a higher value of A[7:0] gives a higher Second Pre-charge speed.</p> <p>Note ⁽¹⁾ The default values of A[7:0] in 8Ah, A[7:0] in 8Bh and A[7:0] in 8Ch are equal to the contrast values for color A, B and C(refer to commands: 81h, 82h, 83h) respectively. ⁽²⁾ All six bytes (8Ah A[7:0], 8Bh A[7:0] and 8Ch A[7:0]) must be inputted together. For example: the original value is like that</p> <table border="1"> <thead> <tr> <th colspan="2">Original value</th> </tr> </thead> <tbody> <tr> <td>8Ah A[7:0]:</td> <td>80h</td> </tr> <tr> <td>8Bh A[7:0]:</td> <td>80h</td> </tr> <tr> <td>8Ch A[7:0]:</td> <td>80h</td> </tr> </tbody> </table> <p>If it is wanted to change the value of 8Bh A[7:0] to 75h, then all the following 6 bytes must be inputted: 8Ah,80h, 8Bh,75h, 8Ch,80h.</p>	Original value		8Ah A[7:0]:	80h	8Bh A[7:0]:	80h	8Ch A[7:0]:	80h	A[7:0] of 81h A[7:0] of 82h A[7:0] of 83h
Original value																				
8Ah A[7:0]:	80h																			
8Bh A[7:0]:	80h																			
8Ch A[7:0]:	80h																			
0 0	A0 A[7:0]	1 A ₇	0 A ₆	1 A ₅	0 A ₄	0 A ₃	0 A ₂	0 A ₁	0 A ₀			Remap & Color Depth setting	Set driver remap and color depth A[0]=0, Horizontal address increment A[0]=1, Vertical address increment A[1]=0, RAM Column 0 to 95 maps to Pin Seg (SA,SB,SC) 0 to 95 A[1]=1, RAM Column 0 to 95 maps to Pin Seg (SA,SB,SC) 95 to 0 A[2]=0, normal order SA,SB,SC (e.g. RGB) A[2]=1, reverse order SC,SB,SA (e.g. BGR) A[3]=0, Disable left-right swapping on COM A[3]=1, Set left-right swapping on COM A[4]=0, Scan from COM 0 to COM [N -1] A[4]=1, Scan from COM [N-1] to COM0. Where N is the multiplex ratio. A[5]=0, Disable COM Split Odd Even (RESET) A[5]=1, Enable COM Split Odd Even A[7:6] = 00; 256 color format A[7:6] = 01; 65k color format A[7:6] = 10; 65k color format 2 If 9 / 18 bit mode is selected, color depth will be fixed to 65k regardless of the setting.	A[0]=0 A[1]=0 A[2]=0 A[3]=0 A[4]=0 A[5]=0 A[7:6]=01						
0 0	A1 A[5:0]	1 0	0 0	1 A ₅	0 A ₄	0 A ₃	0 A ₂	0 A ₁	1 A ₀	Set Display Start Line	Set display start line register by Row A[5:0]: from 00d to 63d		00d (00h)							
0 0	A2 A[5:0]	1 0	0 0	1 A ₅	0 A ₄	0 A ₃	0 A ₂	1 A ₁	0 A ₀	Set Display Offset	Set vertical offset by Com A[5:0]: from 00d to 63d		00d (00h)							

Fundamental Commands												
D/C#	Hex	D7	D6	D5	D4	D3	D2	D1	D0	Command	Description	Default
00	A4 / A5 / A6 / A7 /	1	0	1	0	0	1	X ₁	X ₀	Set Display Mode	A4h=Normal Display A5h=Entire Display ON, all pixels turn ON at GS63 A6h=Entire Display OFF, all pixels turn OFF A7h=Inverse Display	A4h
00	A8 A[5:0]	1 0	0 0	1 A ₅	0 A ₄	1 A ₃	0 A ₂	0 A ₁	0 A ₀	Set Multiplex Ratio	Set MUX ratio to N+1 Mux N = A[5:0] from 15d to 63d A[5:0] from 00d to 14d are invalid entry	63d (3Fh)
000000	AB A[7:0] B[7:0] C[7:0] D[7:0] E[4:0]	1 A ₇	0 A ₆	1 A ₅	0 A ₄	1 A ₃	0 A ₂	1 A ₁	1 A ₀	Dim Mode Setting	Configure dim mode setting A[7:0] = Reserved. (Set as 00h) B[7:0] = Contrast setting for Color A, valid range 0 to 255d. C[7:0] = Contrast setting for Color B, valid range 0 to 255d. D[7:0] = Contrast setting for Color C, valid range 0 to 255d. E[4:0] = Precharge voltage setting, valid range 0 to 31d.	\
00	AD A[0]	1 1	0 0	1 0	0 0	1 1	1 1	0 1	1 A ₀	Set Master Configuration	A[0]=0b, Select external V _{CC} supply A[0]=1b, Reserved (RESET) Note (1) Bit A[0] must be set to 0b after RESET. (2) The setting will be activated after issuing Set Display ON command (AFh)	A[0] = 1
0	AC AE AF	1	0	1	0	1	1	A ₁	A ₀	Set Display ON/OFF	ACH = Display ON in dim mode AEh = Display OFF (sleep mode) AFh = Display ON in normal mode	AEh
00	B0 A[7:0]	1 A ₇	0 A ₆	1 A ₅	1 A ₄	0 A ₃	0 A ₂	0 A ₁	0 A ₀	Power Save Mode	A[7:0]=1Ah, Enable Power save mode (RESET) A[7:0]=0Bh, Disable Power save mode	1Ah
00	B1 A[7:0]	1 A ₇	0 A ₆	1 A ₅	1 A ₄	0 A ₃	0 A ₂	0 A ₁	1 A ₀	Phase 1 and 2 period adjustment	A[3:0] Phase 1 period in N DCLK. 1~15 DCLK allowed. A[7:4] Phase 2 period in N DCLK. 1~15 DCLK allowed Note (1) 0 DCLK is invalid in phase 1 & phase 2	74h
00	B3 A[7:0]	1 A ₇	0 A ₆	1 A ₅	1 A ₄	0 A ₃	0 A ₂	1 A ₁	1 A ₀	Display Clock Divider / Oscillator Frequency	A[3:0]: Define the divide ratio (D) of the display clocks (DCLK): Divide ratio (D) = A[3:0] + 1 (i.e., 1 to 16) A[7:4] Fosc frequency. Frequency increases as setting value increases	D0h

Fundamental Commands																														
D/C#	Hex	D7	D6	D5	D4	D3	D2	D1	D0	Command	Description	Default																		
0	B8	1	0	1	1	1	0	0	0	Set Gray Scale Table	These 32 parameters define pulse widths of GS1 to GS63 in terms of DCLK A[6:0]: Pulse width for GS1, RESET=01d B[6:0]: Pulse width for GS3, RESET=05d C[6:0]: Pulse width for GS5, RESET=09d ... AE[6:0]: Pulse width for GS61, RESET=121d AF[6:0]: Pulse width for GS63, RESET=125d Note: ⁽¹⁾ GS0 has no pre-charge and current drive stages. ⁽²⁾ GS2, GS4...GS62 are derived by $P_n = (P_{n-1} + P_{n+1})/2$ ⁽³⁾ P _n will be truncated to integer if it is with decimal point. ⁽⁴⁾ P _{n+1} should always be set to larger than P _{n-1} ⁽⁵⁾ Max pulse width is 125	\																		
0	A[6:0]	*	A ₆	A ₅	A ₄	A ₃	A ₂	A ₁	A ₀																					
0	B[6:0]	*	B ₆	B ₅	B ₄	B ₃	B ₂	B ₁	B ₀																					
0	C[6:0]	*	C ₆	C ₅	C ₄	C ₃	C ₂	C ₁	C ₀																					
0																					
0	AE[6:0]	*	AE ₆	AE ₅	AE ₄	AE ₃	AE ₂	AE ₁	AE ₀																					
0	AF[6:0]	*	AF ₆	AF ₅	AF ₄	AF ₃	AF ₂	AF ₁	AF ₀																					
0	B9	1	0	1	1	1	0	0	1	Enable Linear Gray Scale Table	Reset built in gray scale table (Linear) Pulse width for GS1 = 1d; Pulse width for GS2 = 3d; Pulse width for GS3 = 5d; ... Pulse width for GS61 = 121d; Pulse width for GS62 = 123d; Pulse width for GS63 = 125d.	\																		
0	BB	1	0	1	1	1	0	1	1	Set Pre-charge level	Set pre-charge voltage level. All three color share the same pre-charge voltage. <table border="1"> <thead> <tr> <th>A[5:1]</th> <th>Hex code</th> <th>pre-charge voltage</th> </tr> </thead> <tbody> <tr> <td>00000</td> <td>00h</td> <td>0.10 x V_{CC}</td> </tr> <tr> <td>:</td> <td>:</td> <td>:</td> </tr> <tr> <td>11111</td> <td>3Eh</td> <td>0.50 x V_{CC}</td> </tr> </tbody> </table> Refer to Figure 30 for the details setting of A[5:1].	A[5:1]	Hex code	pre-charge voltage	00000	00h	0.10 x V _{CC}	:	:	:	11111	3Eh	0.50 x V _{CC}	3Eh						
A[5:1]	Hex code	pre-charge voltage																												
00000	00h	0.10 x V _{CC}																												
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0	A[5:0]	0	0	A ₅	A ₄	A ₃	A ₂	A ₁	0																					
0	BC-BD	1	0	1	1	1	1	0	X ₀	NOP	Command for No operation	\																		
0	BE	1	0	1	1	1	1	1	0	Set V _{COMH}	Set COM deselect voltage level (V _{COMH}) <table border="1"> <thead> <tr> <th>A[5:1]</th> <th>Hex code</th> <th>V_{COMH}</th> </tr> </thead> <tbody> <tr> <td>00000</td> <td>00h</td> <td>0.44 x V_{CC}</td> </tr> <tr> <td>01000</td> <td>10h</td> <td>0.52 x V_{CC}</td> </tr> <tr> <td>10000</td> <td>20h</td> <td>0.61 x V_{CC}</td> </tr> <tr> <td>11000</td> <td>30h</td> <td>0.71 x V_{CC}</td> </tr> <tr> <td>11111</td> <td>3Eh</td> <td>0.83 x V_{CC}</td> </tr> </tbody> </table>	A[5:1]	Hex code	V _{COMH}	00000	00h	0.44 x V _{CC}	01000	10h	0.52 x V _{CC}	10000	20h	0.61 x V _{CC}	11000	30h	0.71 x V _{CC}	11111	3Eh	0.83 x V _{CC}	3Eh
A[5:1]	Hex code	V _{COMH}																												
00000	00h	0.44 x V _{CC}																												
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11111	3Eh	0.83 x V _{CC}																												
0	A[5:1]	0	0	A ₅	A ₄	A ₃	A ₂	A ₁	0																					
0	E3	1	1	1	0	0	0	1	1	NOP	Command for No operation	\																		
0	FD	1	1	1	1	1	1	0	1	Set Command Lock	A[2]: MCU protection status A[2] = 0b, Unlock OLED driver IC MCU interface from entering command [reset] A[2] = 1b, Lock OLED driver IC MCU interface from entering command Note ⁽¹⁾ The locked OLED driver IC MCU interface prohibits all commands and memory access except the FDh command.	12h																		
0	A[2]	0	0	0	1	0	A ₂	1	0																					

Graphic Acceleration Commands											
D/C#	Hex	D7	D6	D5	D4	D3	D2	D1	D0	Command	Description
0	21	0	0	1	0	0	0	0	1	Draw Line	A[6:0]: Column Address of Start
0	A[6:0]	*	A ₆	A ₅	A ₄	A ₃	A ₂	A ₁	A ₀		B[5:0]: Row Address of Start
0	B[5:0]	*	*	B ₅	B ₄	B ₃	B ₂	B ₁	B ₀		C[6:0]: Column Address of End
0	C[6:0]	*	C ₆	C ₅	C ₄	C ₃	C ₂	C ₁	C ₀		D[5:0]: Row Address of End
0	D[5:0]	*	*	D ₅	D ₄	D ₃	D ₂	D ₁	D ₀		E[5:1]: Color C of the line
0	E[5:1]	*	*	E ₅	E ₄	E ₃	E ₂	E ₁	*		F[5:0]: Color B of the line
0	F[5:0]	*	*	F ₅	F ₄	F ₃	F ₂	F ₁	F ₀		G[5:1]: Color A of the line
0	G[5:1]	*	*	G ₅	G ₄	G ₃	G ₂	G ₁	*		
0	22	0	0	1	0	0	0	1	0	Drawing Rectangle	A[6:0]: Column Address of Start
0	A[6:0]	*	A ₆	A ₅	A ₄	A ₃	A ₂	A ₁	A ₀		B[5:0]: Row Address of Start
0	B[5:0]	*	*	B ₅	B ₄	B ₃	B ₂	B ₁	B ₀		C[6:0]: Column Address of End
0	C[6:0]	*	C ₆	C ₅	C ₄	C ₃	C ₂	C ₁	C ₀		D[5:0]: Row Address of End
0	D[5:0]	*	*	D ₅	D ₄	D ₃	D ₂	D ₁	D ₀		E[5:1]: Color C of the line
0	E[5:1]	*	*	E ₅	E ₄	E ₃	E ₂	E ₁	*		F[5:0]: Color B of the line
0	F[5:0]	*	*	F ₅	F ₄	F ₃	F ₂	F ₁	F ₀		G[5:1]: Color A of the line
0	G[5:1]	*	*	G ₅	G ₄	G ₃	G ₂	G ₁	*		H[5:1]: Color C of the fill area
0	H[5:1]	*	*	H ₅	H ₄	H ₃	H ₂	H ₁	*		I[5:0]: Color B of the fill area
0	I[5:0]	*	*	I ₅	I ₄	I ₃	I ₂	I ₁	I ₀		J[5:1]: Color A of the fill area
0	J[5:1]	*	*	J ₅	J ₄	J ₃	J ₂	J ₁	*		
0	23	0	0	1	0	0	0	1	1	Copy	A[6:0]: Column Address of Start
0	A[6:0]	*	A ₆	A ₅	A ₄	A ₃	A ₂	A ₁	A ₀		B[5:0]: Row Address of Start
0	B[5:0]	*	*	B ₅	B ₄	B ₃	B ₂	B ₁	B ₀		C[6:0]: Column Address of End
0	C[6:0]	*	C ₆	C ₅	C ₄	C ₃	C ₂	C ₁	C ₀		D[5:0]: Row Address of End
0	D[5:0]	*	*	D ₅	D ₄	D ₃	D ₂	D ₁	D ₀		E[6:0]: Column Address of New Start
0	E[6:0]	*	E ₆	E ₅	E ₄	E ₃	E ₂	E ₁	E ₀		F[5:0]: Row Address of New Start
0	F[5:0]	*	*	F ₅	F ₄	F ₃	F ₂	F ₁	F ₀		
0	24	0	0	1	0	0	1	0	0	Dim Window	A[6:0]: Column Address of Start
0	A[6:0]	*	A ₆	A ₅	A ₄	A ₃	A ₂	A ₁	A ₀		B[5:0]: Row Address of Start
0	B[5:0]	*	*	B ₅	B ₄	B ₃	B ₂	B ₁	B ₀		C[6:0]: Column Address of End
0	C[6:0]	*	C ₆	C ₅	C ₄	C ₃	C ₂	C ₁	C ₀		D[5:0]: Row Address of End
0	D[5:0]	*	*	D ₅	D ₄	D ₃	D ₂	D ₁	D ₀		The effect of dim window: GS15~GS0 no change GS19~GS16 become GS4 GS23~GS20 become GS5 ... GS63~GS60 become GS15
0	25	0	0	1	0	0	1	0	1	Clear Window	A[6:0]: Column Address of Start
0	A[6:0]	*	A ₆	A ₅	A ₄	A ₃	A ₂	A ₁	A ₀		B[5:0]: Row Address of Start
0	B[5:0]	*	*	B ₅	B ₄	B ₃	B ₂	B ₁	B ₀		C[6:0]: Column Address of End
0	C[6:0]	*	C ₆	C ₅	C ₄	C ₃	C ₂	C ₁	C ₀		D[5:0]: Row Address of End
0	D[5:0]	*	*	D ₅	D ₄	D ₃	D ₂	D ₁	D ₀		
0	26	0	0	1	0	0	1	1	0	Fill Enable / Disable	A0 0 : Disable Fill for Draw Rectangle Command (RESET)
0	A[4:0]	*	*	*	A ₄	0	0	0	A ₀		1 : Enable Fill for Draw Rectangle Command A[3:1] 000: Reserved values A4 0 : Disable reverse copy (RESET) 1 : Enable reverse during copy command.

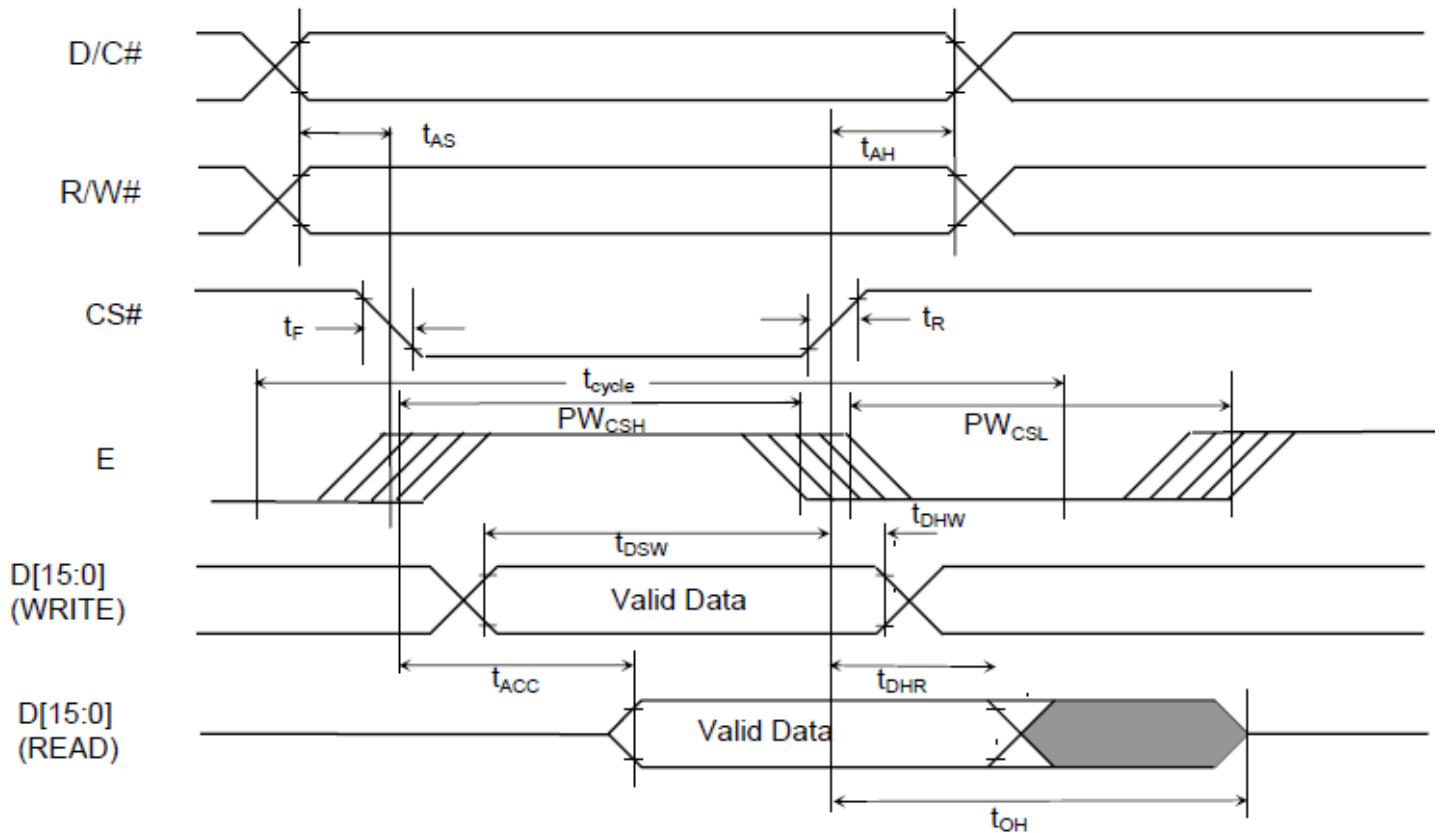
Graphic Acceleration Commands											
D/C#	Hex	D7	D6	D5	D4	D3	D2	D1	D0	Command	Description
0	27	0	0	1	0	0	1	1	1	Continuous Horizontal & Vertical Scrolling Setup	A[6:0]: Set number of column as horizontal scroll offset Range: 0d-95d (no horizontal scroll if equals to 0)
0	A[6:0]	*	A ₆	A ₅	A ₄	A ₃	A ₂	A ₁	A ₀		B[5:0]: Define start row address
0	B[5:0]	*	*	B ₅	B ₄	B ₃	B ₂	B ₁	B ₀		C[6:0]: Set number of rows to be horizontal scrolled B[5:0]+C[6:0] <=64
0	C[6:0]	*	C ₆	C ₅	C ₄	C ₃	C ₂	C ₁	C ₀		D[5:0]: Set number of row as vertical scroll offset Range: 0d-63d (no vertical scroll if equals to 0)
0	D[5:0]	*	*	D ₅	D ₄	D ₃	D ₂	D ₁	D ₀		E[1:0]: Set time interval between each scroll step 00b 6 frames 01b 10 frames 10b 100 frames 11b 200 frames
0	E[1:0]	*	*	*	*	*	*	E ₁	E ₀	Note: ⁽¹⁾ Vertical scroll is run with 64MUX setting only ⁽²⁾ The parameters should not be changed after scrolling is activated	
0	2E	0	0	1	0	1	1	1	0	Deactivate scrolling	This command deactivates the scrolling action. Note ⁽¹⁾ After sending 2Eh command to deactivate the scrolling action, the ram data needs to be rewritten.
0	2F	0	0	1	0	1	1	1	1	Activate scrolling	This command activates the scrolling function according to the setting done by Continuous Horizontal & Vertical Scrolling Setup command 27h.

For the full command table descriptions, please download the following:
<http://www.newhavendisplay.com/appnotes/datasheets/OLEDs/SSD1331.pdf>

Timing Characteristics

Parallel (6800 mode):

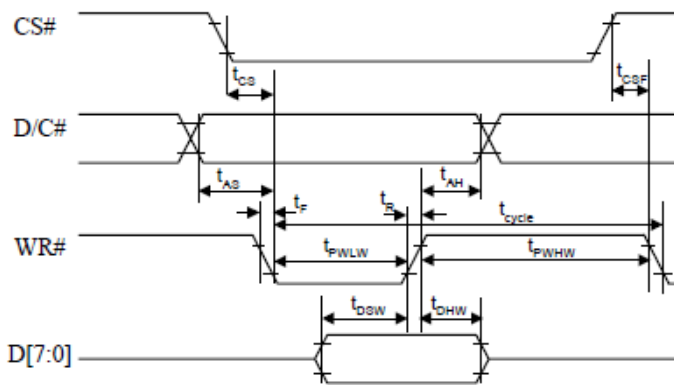
Symbol	Parameter	Min	Typ	Max	Unit
t_{cycle}	Clock Cycle Time (write cycle)	130	-	-	ns
PW_{CSL}	Control Pulse Low Width (write cycle)	60	-	-	ns
PW_{CSH}	Control Pulse High Width (write cycle)	60	-	-	ns
t_{cycle}	Clock Cycle Time (read cycle)	200	-	-	ns
PW_{CSL}	Control Pulse Low Width (read cycle)	100	-	-	ns
PW_{CSH}	Control Pulse High Width (read cycle)	100	-	-	ns
t_{AS}	Address Setup Time	0	-	-	ns
t_{AH}	Address Hold Time	10	-	-	ns
t_{DSW}	Data Setup Time	40	-	-	ns
t_{DHW}	Data Hold Time	10	-	-	ns
t_{ACC}	Data Access Time	-	-	140	ns
t_{OH}	Output Hold time	-	-	70	ns
t_R	Rise Time	-	-	15	ns
t_F	Fall Time	-	-	15	ns



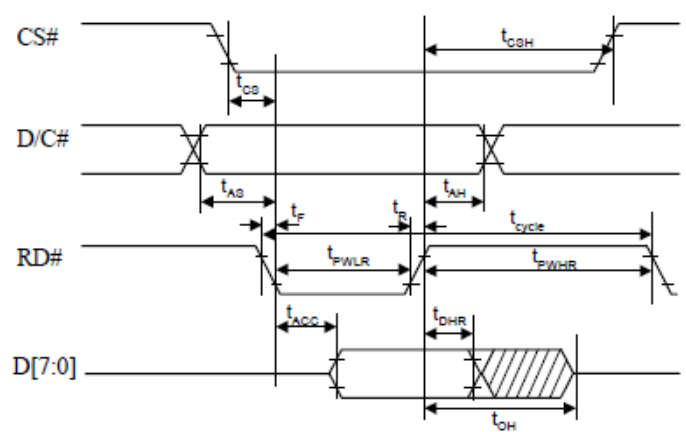
Parallel (8080 mode):

Symbol	Parameter	Min	Typ	Max	Unit
t_{cycle}	Clock Cycle Time	130	-	-	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_{PWLW}	Read Low Time	150	-	-	ns
t_{PWLW}	Write Low Time	60	-	-	ns
t_{PWHR}	Read High Time	60	-	-	ns
t_{PWHW}	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

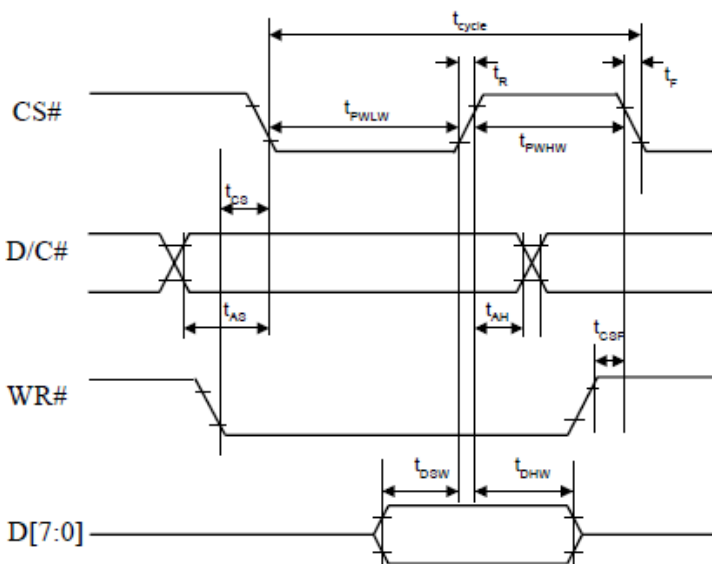
Write cycle (Form 1)



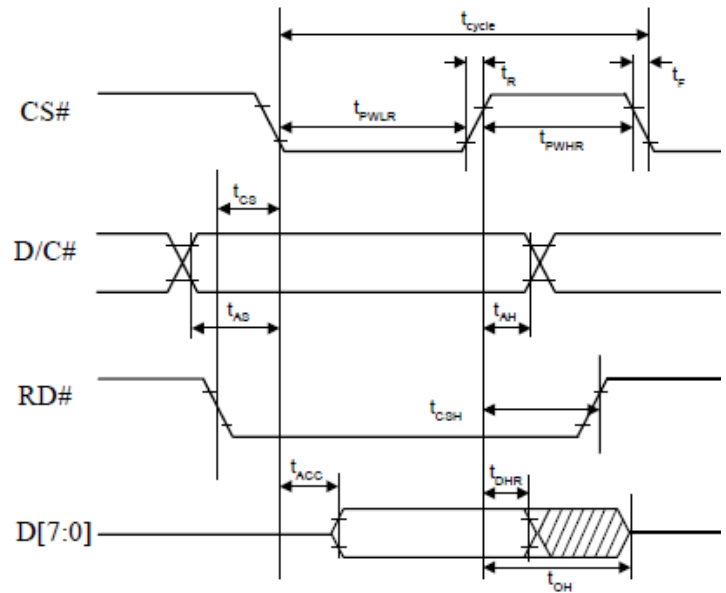
Read cycle (Form 1)



Write cycle (Form 2)

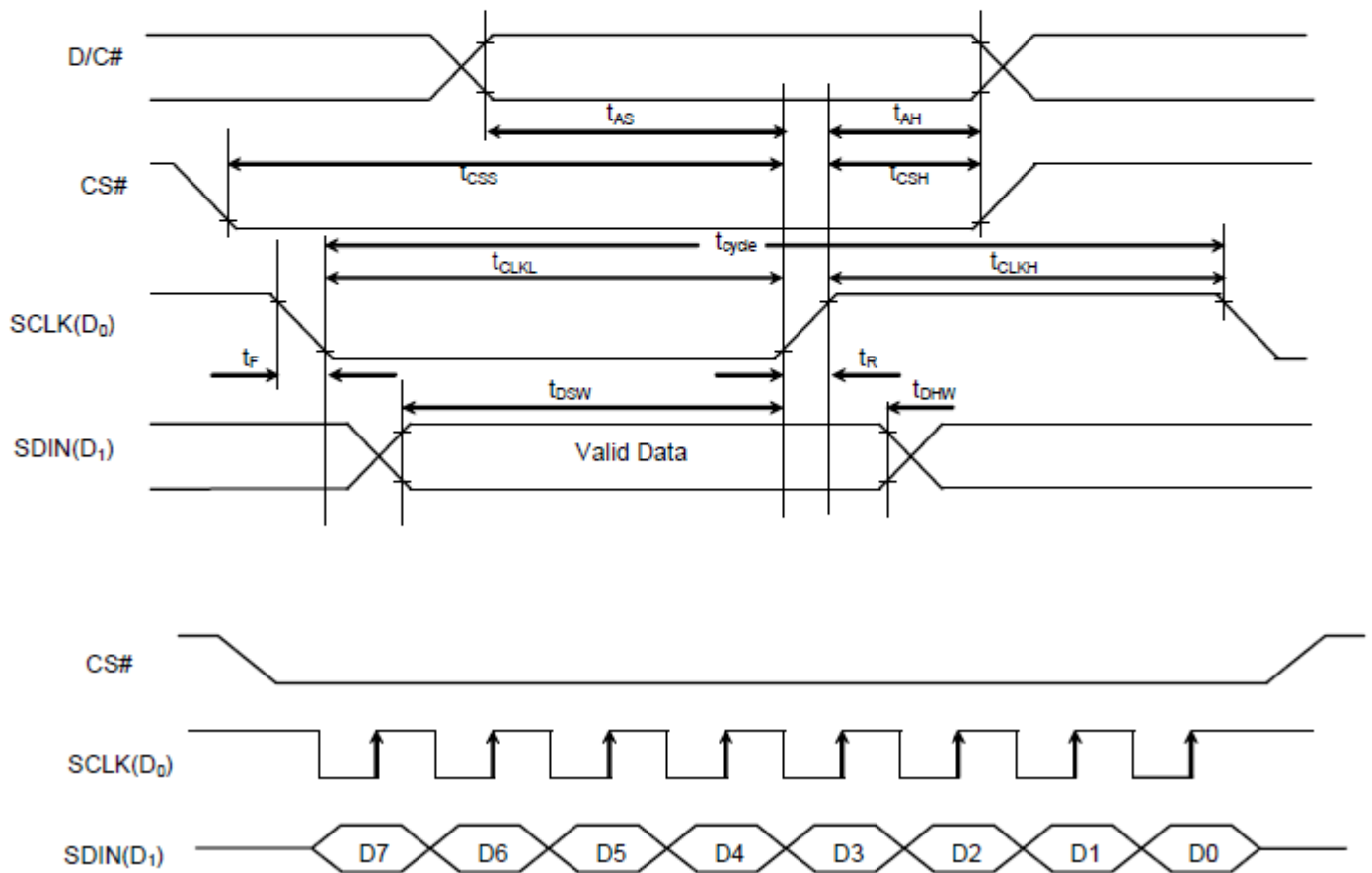


Read cycle (Form 2)



4-wire SPI:

Symbol	Parameter	Min	Typ	Max	Unit
t_{cycle}	Clock Cycle Time	150	-	-	ns
t_{AS}	Address Setup Time	40	-	-	ns
t_{AH}	Address Hold Time	40	-	-	ns
t_{CSS}	Chip Select Setup Time	75	-	-	ns
t_{CSH}	Chip Select Hold Time	60	-	-	ns
t_{OSW}	Write Data Setup Time	40	-	-	ns
t_{OHV}	Write Data Hold Time	40	-	-	ns
t_{CLKL}	Clock Low Time	75	-	-	ns
t_{CLKH}	Clock High Time	75	-	-	ns
t_R	Rise Time	-	-	15	ns
t_F	Fall Time	-	-	15	ns



Example Initialization Sequence:

```
void OLED_Init_9664RGB(void)
{
  GPIO_ResetBits(RES_pin);
  delay_ms(300);
  GPIO_SetBits(RES_pin);
  delay_ms(10);

  oled_Command_9664RGB(0xFD); //Command Unlock
  oled_Command_9664RGB(0x12);

  oled_Command_9664RGB(0xAE); //Set Display OFF

  oled_Command_9664RGB(0xB3); //Set Display Clock Divide Ratio/Oscillator Frequency
  oled_Command_9664RGB(0xF0);

  oled_Command_9664RGB(0xA8); //Set MUX Ratio
  oled_Command_9664RGB(0x3F);

  oled_Command_9664RGB(0xA2); //Set Display Offset
  oled_Command_9664RGB(0x00);

  oled_Command_9664RGB(0xA1); //Set Display Start Line
  oled_Command_9664RGB(0x00);

  oled_Command_9664RGB(0xA0); //Set Re-map & Color Depth
  oled_Command_9664RGB(0x74);

  oled_Command_9664RGB(0xAD); //Set Master Configuration
  oled_Command_9664RGB(0x8E);

  oled_Command_9664RGB(0xB0); //Set Power Saving Mode
  oled_Command_9664RGB(0x0B);

  oled_Command_9664RGB(0xB1); //Set Contrast Current for A
  oled_Command_9664RGB(0x91);

  oled_Command_9664RGB(0xB2); //Set Contrast Current for B
  oled_Command_9664RGB(0x50);

  oled_Command_9664RGB(0xB3); //Set Contrast Current for C
  oled_Command_9664RGB(0x7D);

  oled_Command_9664RGB(0x87); //Master Current Control
  oled_Command_9664RGB(0x06);

  oled_Command_9664RGB(0xB1); //Set Phase Length
  oled_Command_9664RGB(0x31);

  oled_Command_9664RGB(0xBB); //Set Pre-charge Voltage
  oled_Command_9664RGB(0x3A);

  oled_Command_9664RGB(0x8A); //Set Second Pre-Charge Speed for Color A
  oled_Command_9664RGB(0x64);
```



```
oled_Command_9664RGB(0x8B); //Set Second Pre-Charge Speed for Color B
oled_Command_9664RGB(0x78);

oled_Command_9664RGB(0x8C); //Set Second Pre-Charge Speed for Color C
oled_Command_9664RGB(0x64);

oled_Command_9664RGB(0xBE); //Set VCOMH
oled_Command_9664RGB(0x3E);

oled_Command_9664RGB(0xA4); //Set Display Mode

oled_Clear_Screen();          //Clear Display

oled_Command_9664RGB(0xAF); //Set Display ON

delay_ms(100);
}
```

Quality Information

Test Item	Content of Test	Test Condition	Note
High Temperature storage	Test the endurance of the display at high storage temperature.	+85°C, 240 Hrs.	2
Low Temperature storage	Test the endurance of the display at low storage temperature.	-40°C, 240 Hrs.	1,2
High Temperature Operation	Test the endurance of the display by applying electric stress (voltage & current) at high temperature.	+70°C, 240 Hrs.	2
Low Temperature Operation	Test the endurance of the display by applying electric stress (voltage & current) at low temperature.	-40°C, 240 Hrs.	1,2
High Temperature / Humidity Operation	Test the endurance of the display by applying electric stress (voltage & current) at high temperature with high humidity.	+60°C, 90% RH, 120 Hrs.	1,2
Thermal Shock resistance	Test the endurance of the display by applying electric stress (voltage & current) during a cycle of low and high temperatures.	-40°C, 30 min -> 25°C, 5 min -> 70°C, 30 min = 1 cycle 100 Cycles	
Vibration test	Test the endurance of the display by 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	Test the endurance of the display by applying electric static discharge.	V _s =800V, R _s =1.5kΩ, C _s =100pF One time	

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.

Evaluation Criteria:

- 1: Display is fully functional during operational tests and after all tests, at room temperature.
- 2: No observable defects.
- 3: Luminance >50% of initial value.
- 4: Current consumption within 50% of initial value

Precautions for using OLEDs/LCDs/LCMs

See Precautions at www.newhavendisplay.com/specs/precautions.pdf

Warranty Information

See Terms & Conditions at http://www.newhavendisplay.com/index.php?main_page=terms