NEWHAVEN DISPLAY INTERNATIONAL

Product Specification

NHD-0.95-9664G

Graphic Color OLED Display Module

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

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REACH Compliant

RoHS Compliant

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Table of Contents

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

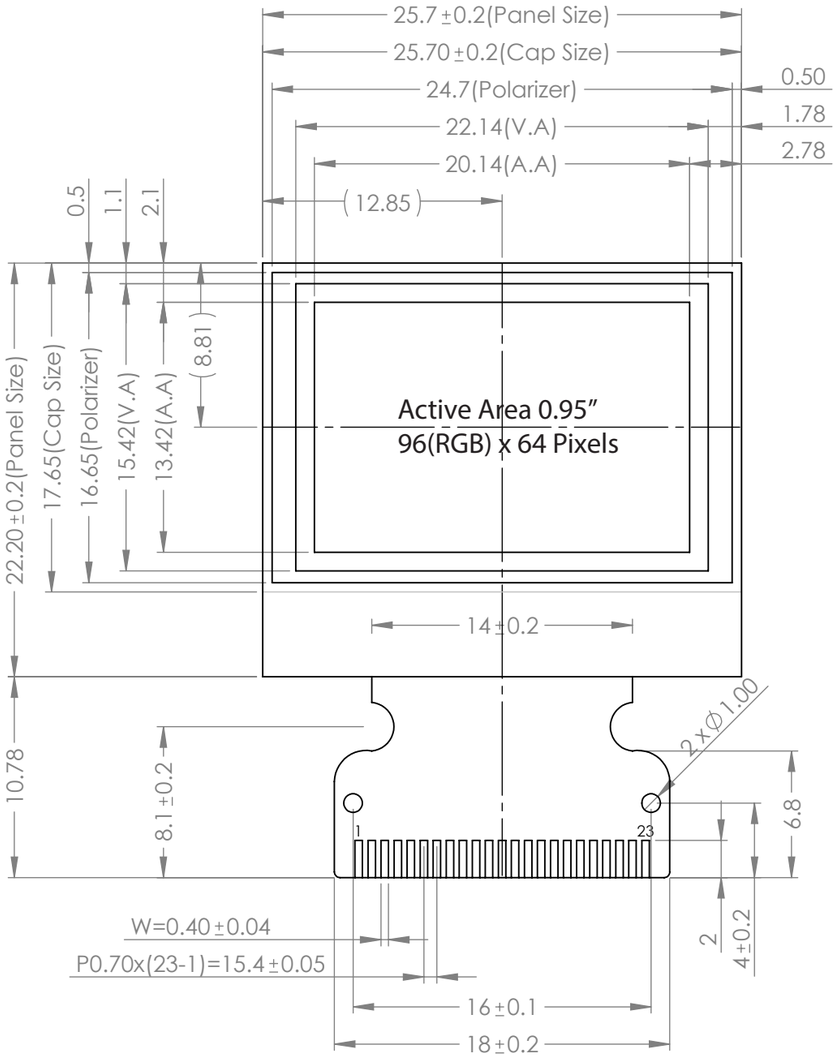
Document Revision History

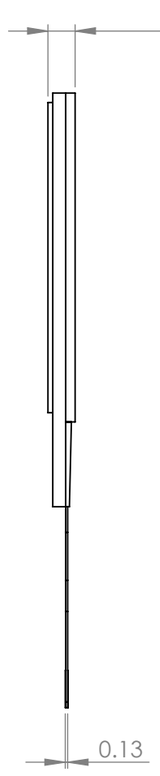
Revision	Date	Description	Changed By
-	01/21/2019	Initial Release	ML
1	04/26/2024	Added Chromaticity Values in Optical Characteristics	KL
2	07/25/2024	Example Initialization Sequence Updated	KL

Mechanical Drawing

Newhaven Display
NHD-0.95-9664G
Date Code

Part Label (type/format may vary)





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.

Product Description: 0.95" 69x64 Color OLED

1. Driver IC: SSD1331
2. Interface: 8-bit 6800/8080 Parallel, 4-wire SPI
3. Power Requirement: 3.3V OLED
4. Optical Features: Full Color, Anti-Glare, Full View

Standard Tolerance:
(Unless otherwise specified)
Linear: ±0.3mm

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Drawing/Part Number:	Revision:
NHD-0.95-9664G	-

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

Drawn By:	Approved By:
K. Lewis	K. Lewis
Drawn Date: 04/26/2024	Approved Date: 04/26/2024

Pin 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)

Interface Selection

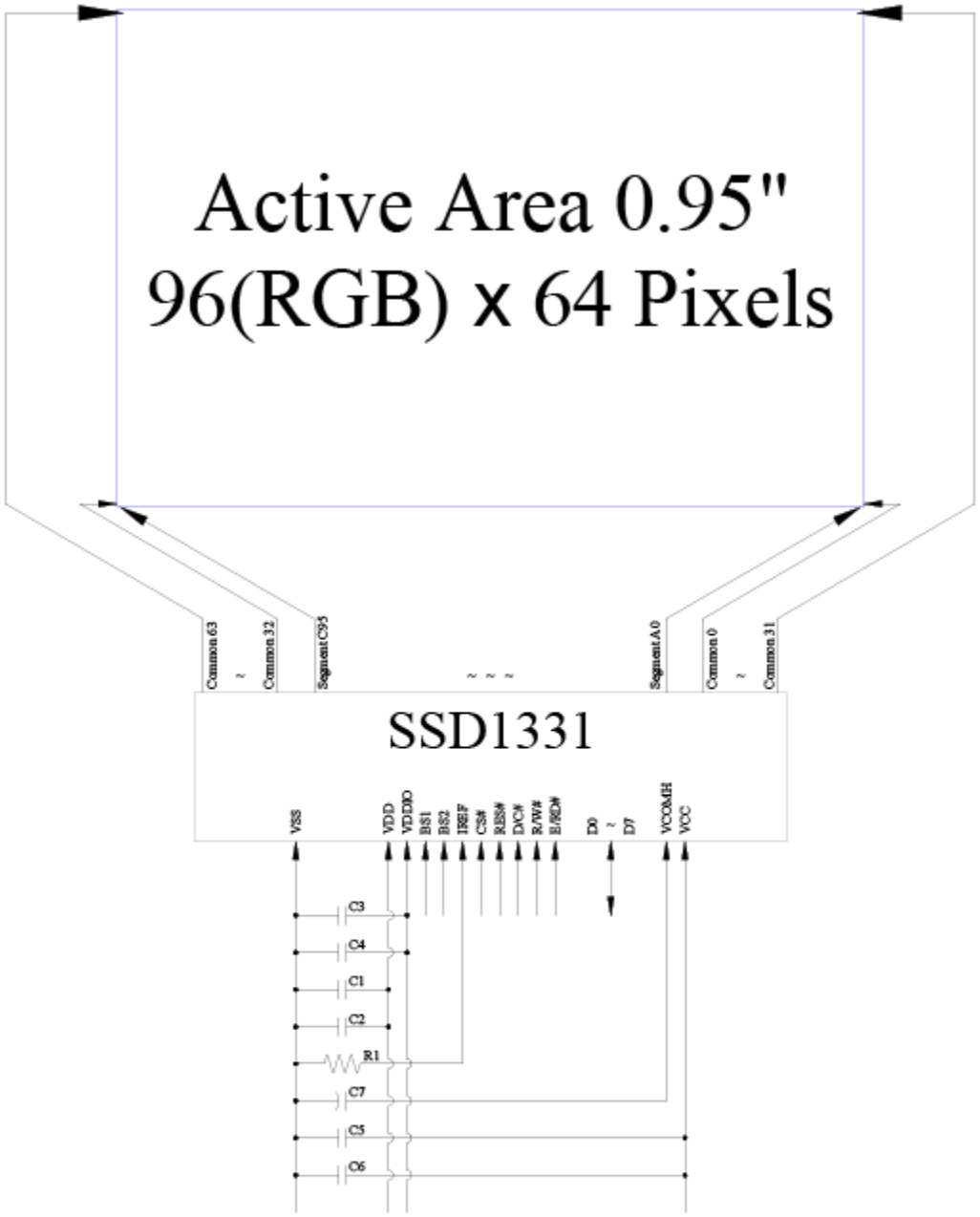
MPU Interface Pin Assignment Summary

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: 0.1µF
C2, C4: 4.7µF
C6: 10µF
C7: 4.7µF / 25V Tantalum Capacitor
R1: 1.2MΩ, R1 = (Voltage at IREF - VSS) / 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	φY+	-	80	-	-	°
	Bottom	φY-		80	-	-	°
	Left	θX-		80	-	-	°
	Right	θX+		80	-	-	°
Contrast Ratio		CR	-	-	>10,000:1	-	-
Response Time	Rise	T_R	-	-	10	-	µs
	Fall	T_F		-	10	-	µs
Brightness		L_V	50% Checkerboard	80	90	-	cd/m²
Lifetime		-	100 cd/m², T_{OP} =25°C, 50% Checkerboard	10,000	-	-	Hrs.
Chromaticity	Red	X_R	-	0.60	0.64	0.68	-
		Y_R	-	0.30	0.34	0.38	-
	Green	X_G	-	0.27	0.31	0.35	-
		Y_G	-	0.58	0.62	0.66	-
	Blue	X_B	-	0.10	0.14	0.18	-
		Y_B	-	0.12	0.16	0.20	-
	White	X_W	-	0.26	0.30	0.34	-
		Y_W	-	0.29	0.33	0.37	-

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: https://support.newhavendisplay.com/hc/en-us/articles/4414853586583-SSD1331

Table of Commands

Fundamental Commands												
D/C#	Hex	D7	D6	D5	D4	D3	D2	D1	D0	Command	Description	Default
0	15	0	0	0	1	0	1	0	1		Setup Column start and end address	
0	A[6:0]	*	A_6	A_5	A_4	A_3	A_2	A_1	A_0		A[6:0] start address from 00d-95d	00d (00h)
0	B[6:0]	*	B_6	B_5	B_4	B_3	B_2	B_1	B_0	Set Column Address	B[6:0] end address from 00d-95d	95d (5Fh)
0	75	0	1	1	1	0	1	0	1		Setup Row start and end address	
0	A[5:0]	*	*	A_5	A_4	A_3	A_2	A_1	A_0		A[5:0] start address from 00d-63d	00d (00h)
0	B[5:0]	*	*	B_5	B_4	B_3	B_2	B_1	B_0	Set Row Address	B[5:0] end address from 00d-63d	63d (3Fh)
0	81	1	0	0	0	0	0	0	1		Set contrast for all color "A" segment (Pins:SA0 – SA95)	
0	A[7:0]	A_7	A_6	A_5	A_4	A_3	A_2	A_1	A_0	Set Contrast for Color "A"	A[7:0] valid range: 00d to 255d	128d (80h)
0	82	1	0	0	0	0	0	1	0		Set contrast for all color "B" segment (Pins:SB0 – SB95).	
0	A[7:0]	A_7	A_6	A_5	A_4	A_3	A_2	A_1	A_0	Set Contrast for Color "B"	A[7:0] valid range: 00d to 255d	128d (80h)
0	83	1	0	0	0	0	0	1	1		Set contrast for all color "C" segment (Pins:SC0 – SC95).	
0	A[7:0]	A_7	A_6	A_5	A_4	A_3	A_2	A_1	A_0	Set Contrast for Color "C"	A[7:0] valid range: 00d to 255d	128d (80h)
0	87	1	0	0	0	0	1	1	1		Set master current attenuation factor	
0	A[3:0]	0	0	0	0	A_3	A_2	A_1	A_0	Master Current Control	A[3:0] from 00d to 15d corresponding to 1/16, 2/16… to 16/16 attenuation.	15d (0Fh)

Fundamental Commands

D/C#	Hex	D7	D6	D5	D4	D3	D2	D1	D0	Command	Description	Default
0	8A	1	0	0	0	1	0	1	0	Set Second Pre-charge Speed for Color "A", "B" and "C"	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. **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 Original value: 8Ah A[7:0]: 80h; 8Bh A[7:0]: 80h; 8Ch A[7:0]: 80h 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.*	A[7:0] of 81h
0	A[7:0]	A_7	A_6	A_5	A_4	A_3	A_2	A_1	A_0			
0	8B	1	0	0	0	1	0	1	1			A[7:0] of 82h
0	A[7:0]	A_7	A_6	A_5	A_4	A_3	A_2	A_1	A_0			
0	8C	1	0	0	0	1	1	0	0			A[7:0] of 83h
0	A[7:0]	A_7	A_6	A_5	A_4	A_3	A_2	A_1	A_0			
0	A0	1	0	1	0	0	0	0	0	Remap & Color Depth setting	Set driver remap and color depth	
0	A[7:0]	A_7	A_6	A_5	A_4	A_3	A_2	A_1	A_0		A[0]=0, Horizontal address increment A[0]=1, Vertical address increment	A[0]=0
											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[1]=0
											A[2]=0, normal order SA,SB,SC (e.g. RGB) A[2]=1, reverse order SC,SB,SA (e.g. BGR)	A[2]=0
											A[3]=0, Disable left-right swapping on COM A[3]=1, Set left-right swapping on COM	A[3]=0
											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[4]=0
											A[5]=0, Disable COM Split Odd Even (RESET) A[5]=1, Enable COM Split Odd Even	A[5]=0
											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[7:6]=01
0	A1	1	0	1	0	0	0	0	1	Set Display Start Line	Set display start line register by Row	
0	A[5:0]	0	0	A_5	A_4	A_3	A_2	A_1	A_0		A[5:0]: from 00d to 63d	00d (00h)
0	A2	1	0	1	0	0	0	1	0	Set Display Offset	Set vertical offset by Com	
0	A[5:0]	0	0	A_5	A_4	A_3	A_2	A_1	A_0		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
0 0 0 0	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
0 0	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)
0 0 0 0 0 0	AB A[7:0] B[7:0] C[7:0] D[7:0] E[4:0]	1 A_7 B_7 C_7 D_7 0	0 A_6 B_6 C_6 D_6 0	1 A_5 B_5 C_5 D_5 0	0 A_4 B_4 C_4 D_4 E_4	1 A_3 B_3 C_3 D_3 E_3	0 A_2 B_2 C_2 D_2 E_2	1 A_1 B_1 C_1 D_1 E_1	1 A_0 B_0 C_0 D_0 E_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.	\
0 0	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
0 0	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
0 0	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
0 0	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 Pn = (Pn-1+Pn+1)/2 (3) Pn will be truncated to integer if it is with decimal point. (4) Pn+1 should always be set to larger than Pn-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. A[5:1] / Hex code / pre-charge voltage 00000 / 00h / 0.10 x V_{CC} : / : / : 11111 / 3Eh / 0.50 x V_{CC} Refer to Figure 30 for the details setting of A[5:1].	3Eh
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}) 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
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	I0		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) 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.
0	A[4:0]	*	*	*	A_4	0	0	0	A_0		

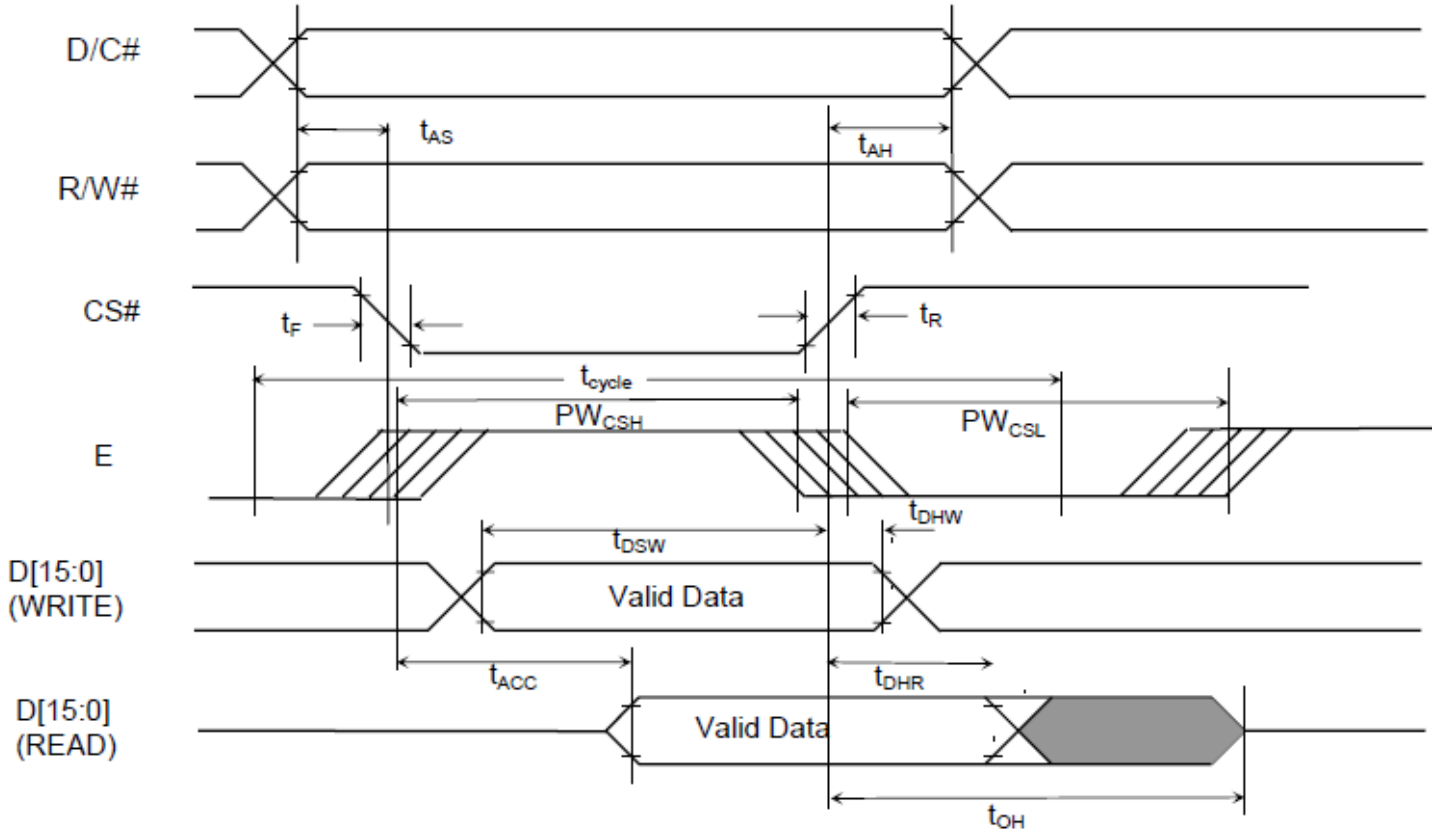
Graphic Acceleration Commands											
D/C#	Hex	D7	D6	D5	D4	D3	D2	D1	D0	Command	Description
0	27	0	0	1	0	0	1	1	1	Continuous Horizontal & Vertical Scrolling Setup	A[6:0]: Set number of column as horizontal scroll offset Range: 0d-95d (no horizontal scroll if equals to 0)
0	A[6:0]	*	A_6	A_5	A_4	A_3	A_2	A_1	A_0		
0	B[5:0]	*	*	B_5	B_4	B_3	B_2	B_1	B_0		B[5:0]: Define start row address
0	C[6:0]	*	C_6	C_5	C_4	C_3	C_2	C_1	C_0		C[6:0]: Set number of rows to be horizontal scrolled B[5:0]+C[6:0] <=64
0	D[5:0]	*	*	D_5	D_4	D_3	D_2	D_1	D_0		D[5:0]: Set number of row as vertical scroll offset Range: 0d-63d (no vertical scroll if equals to 0)
0	E[1:0]	*	*	*	*	*	*	E_1	E_0		E[1:0]: Set time interval between each scroll step 00b 6 frames 01b 10 frames 10b 100 frames 11b 200 frames **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):

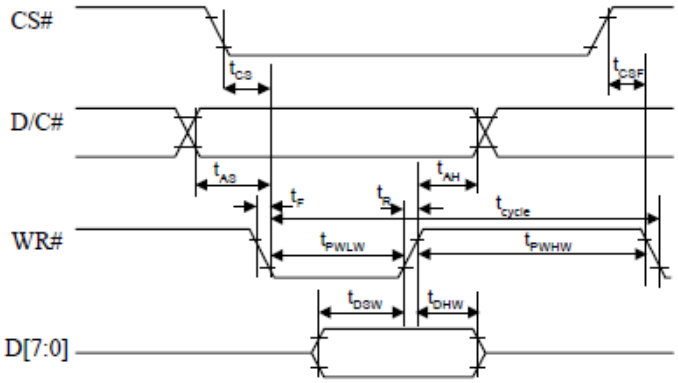
Symbol	Parameter	Min	Typ	Max	Unit
t_{cycle}	Clock Cycle Time (write cycle)	130	-	-	ns
PW_{CSL}	Control Pulse Low Width (write cycle)	60	-	-	ns
PW_{CSH}	Control Pulse High Width (write cycle)	60	-	-	ns
t_{cycle}	Clock Cycle Time (read cycle)	200	-	-	ns
PW_{CSL}	Control Pulse Low Width (read cycle)	100	-	-	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



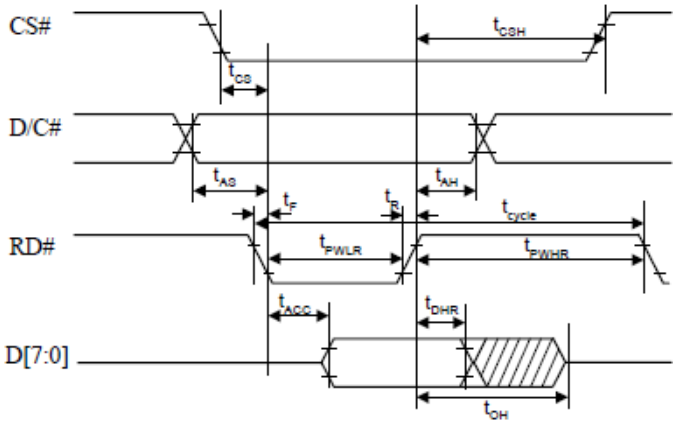
Parallel (8080 mode):

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_{PWLR}	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

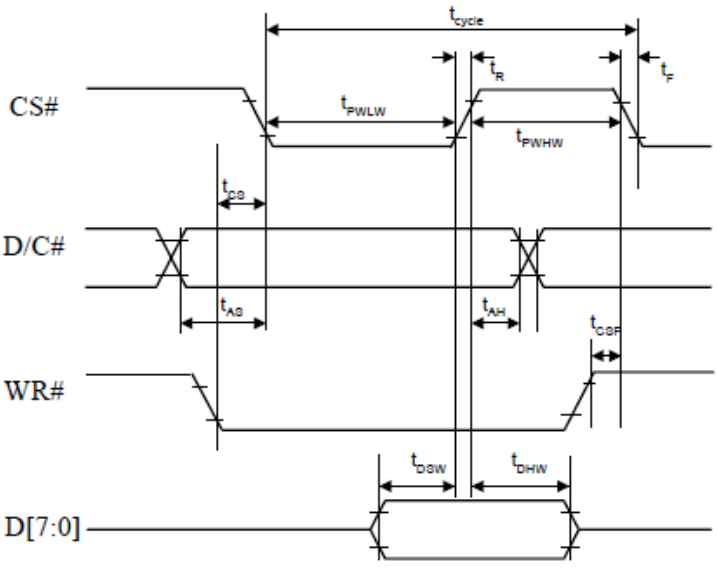
Write cycle (Form 1)



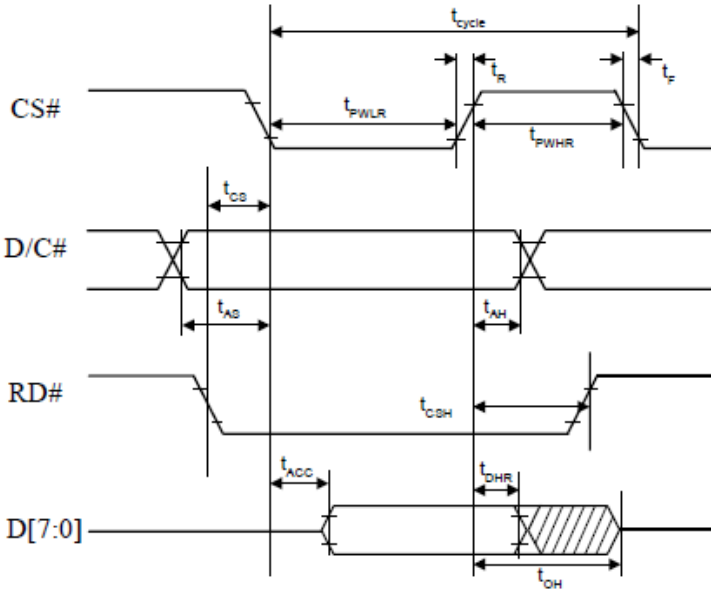
Read cycle (Form 1)



Write cycle (Form 2)

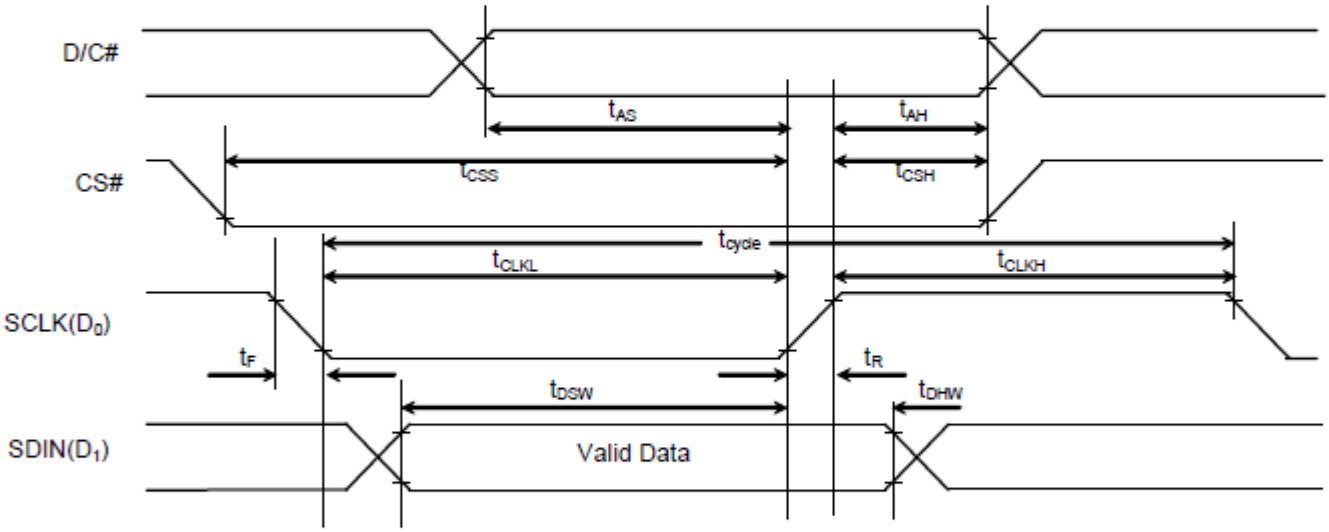


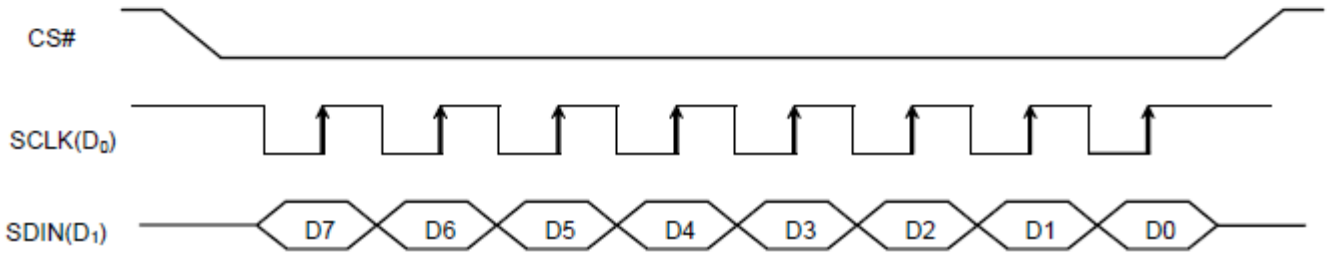
Read cycle (Form 2)



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_{DSW}	Write Data Setup Time	40	-	-	ns
t_{DHW}	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(0x72);

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(0x81);   //Set Contrast Current for A
oled_Command_9664RGB(0x91);

oled_Command_9664RGB(0x82);   //Set Contrast Current for B
oled_Command_9664RGB(0x50);

oled_Command_9664RGB(0x83);   //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_Command_9664RGB(0x25);   //Clear Display
oled_Command_9664RGB(0x00);
oled_Command_9664RGB(0x00);
oled_Command_9664RGB(0x5F);
oled_Command_9664RGB(0x3F);

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