

Product Specification

NHD-1.8-160128UBC3

Full Color Graphic OLED Display Module

NHD-	Newhaven Display
1.8-	1.8" Diagonal Size
160128-	160 x 128 Pixels
UB-	Model
C-	Full Color
3-	3V Power Supply

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Additional Resources

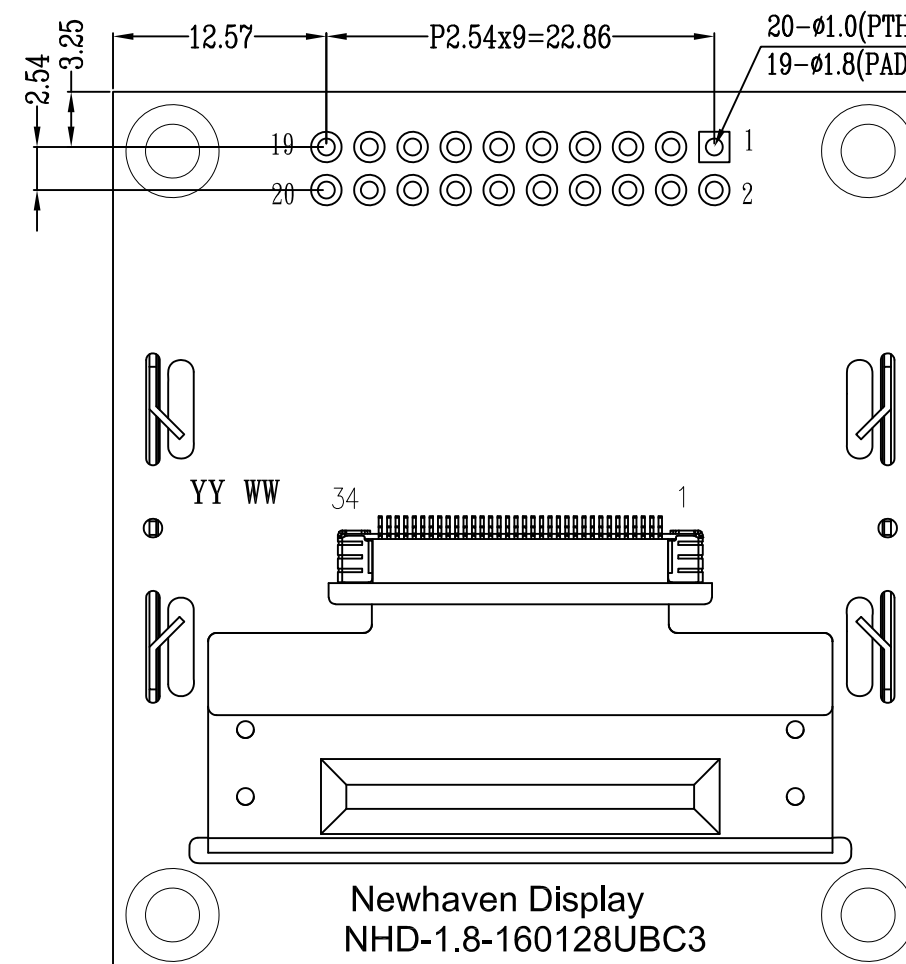
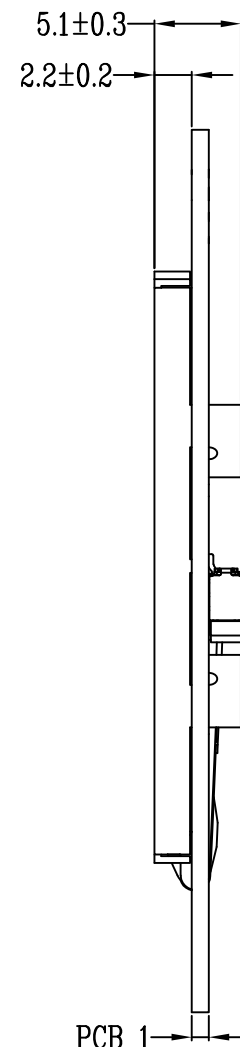
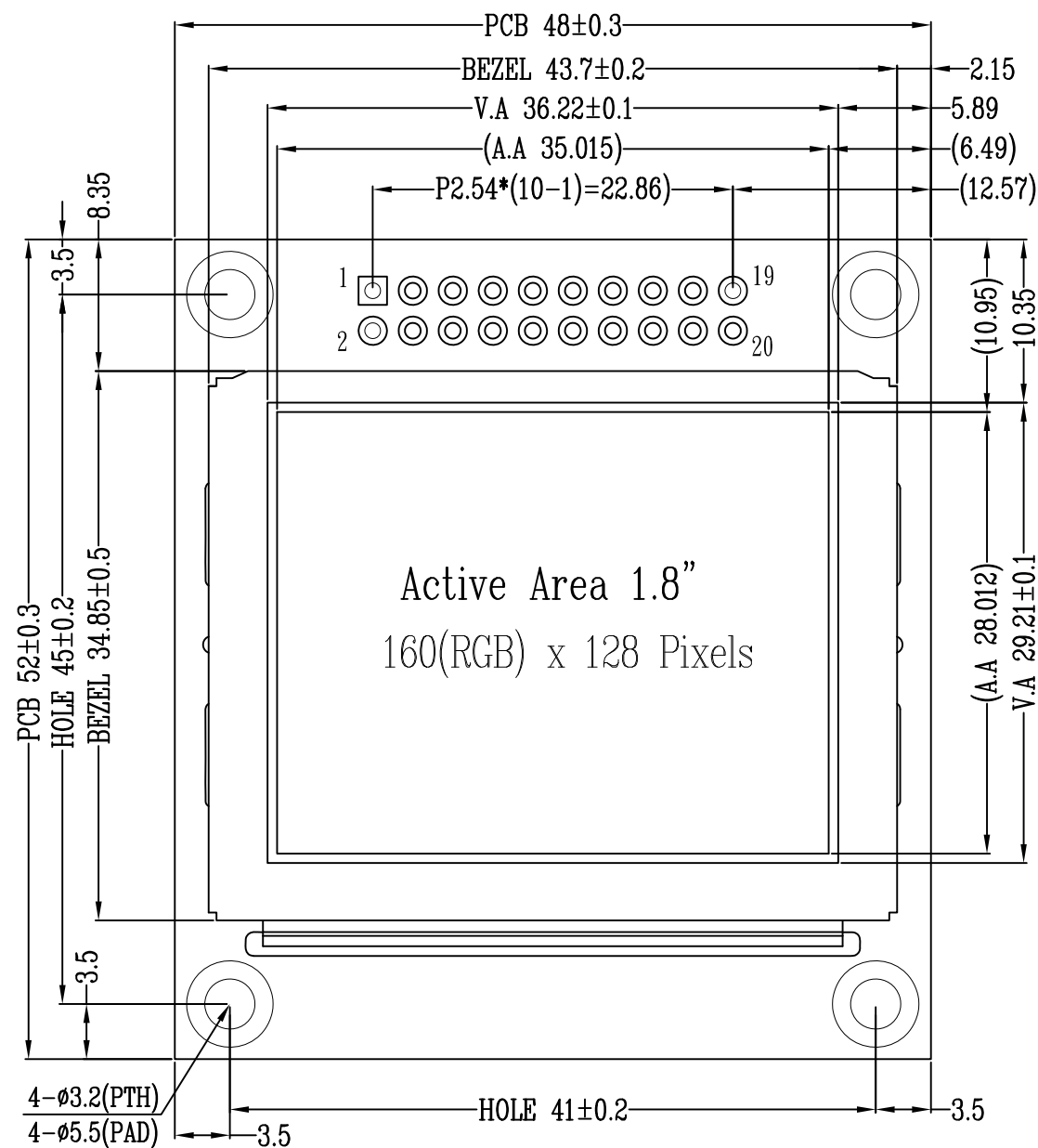
- **Support Forum:** <https://support.newhavendisplay.com/hc/en-us/community/topics>
- **GitHub:** <https://github.com/newhavendisplay>
- **Example Code:** <https://support.newhavendisplay.com/hc/en-us/categories/4409527834135-Example-Code/>
- **Knowledge Center:** https://www.newhavendisplay.com/knowledge_center.html
- **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
-	04/29/2024	Initial Release	KL
1	07/25/2024	Temperature Range Updated in Electrical Characteristics and Quality Information	KL
2	03/05/2025	4-wire SPI Wiring Diagram Updated	KL

Mechanical Drawing



Pin Assignment	
NO.	SYMBOL
1	GND
2	VDD
3	NC
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	GND
16	RES#
17	CS#
18	GND
19	BS1
20	BS2

Product Description: 1.8" 160x128 Color OLED

1. Driver IC: SSD1353

2. Interface: 8-bit 6800/8080 Parallel, 4-wire SPI

3. Power Requirement: 3.3V OLED

4. Optical Features: Full Color, Full View

5. Recommended Pin Header: 2x10pin 2.54mm pitch

Standard Tolerance: (Unless otherwise specified) Linear: ±0.3mm	 NEWHAVEN DISPLAY INTERNATIONAL	
	Drawing/Part Number: NHD-1.8-160128UBC3	Revision: -
Unless otherwise specified: • Dimensions are in Millimeters • Third Angle Projection 	Drawn By: K. Lewis	Approved By: K. Lewis
	Drawn Date: 08/29/2023	Approved Date: 08/29/2023
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Pin Description

Parallel Interface:

Pin No.	Symbol	External Connection	Function Description
1	GND	Power Supply	Ground
2	V _{DD}	Power Supply	Supply Voltage for OLED and logic.
3	NC	-	No Connect
4	D/C#	MPU	Register select signal. D/C=0: Command, D/C=1: Data
5	R/W# WR#	MPU	6800-interface: Read/Write select signal, R/W=1: Read R/W: =0: Write 8080-interface: Active LOW Write signal.
6	E RD#	MPU	6800-interface: Operation enable signal. Falling edge triggered. 8080-interface: Active LOW Read signal.
7-14	DB0 – DB7	MPU	8-bit Bi-directional data bus lines.
15	GND	Power Supply	Ground
16	RES#	MPU	Active LOW Reset signal.
17	CS#	MPU	Active LOW Chip Select signal.
18	GND	Power Supply	Ground
19	BS1	MPU	Interface Select Signal
20	BS2	MPU	Interface Select Signal

4-wire SPI Interface:

Pin No.	Symbol	External Connection	Function Description
1	GND	Power Supply	Ground
2	V _{DD}	Power Supply	Supply Voltage for OLED and logic.
3	NC	-	No Connect
4	D/C#	MPU	Register select signal. D/C=0: Command, D/C=1: Data
5-6	GND	Power Supply	Ground
7	SCLK	MPU	Serial Clock input signal
8	SDIN	MPU	Serial Data input signal
9	NC	-	No Connect
10-15	GND	Power Supply	Ground
16	RES#	MPU	Active LOW Reset signal.
17	CS#	MPU	Active LOW Chip Select signal.
18	GND	Power Supply	Ground
19	BS1	MPU	Interface Select Signal
20	BS2	MPU	Interface Select Signal

Recommended display connector: 2x10pin 2.54mm pitch



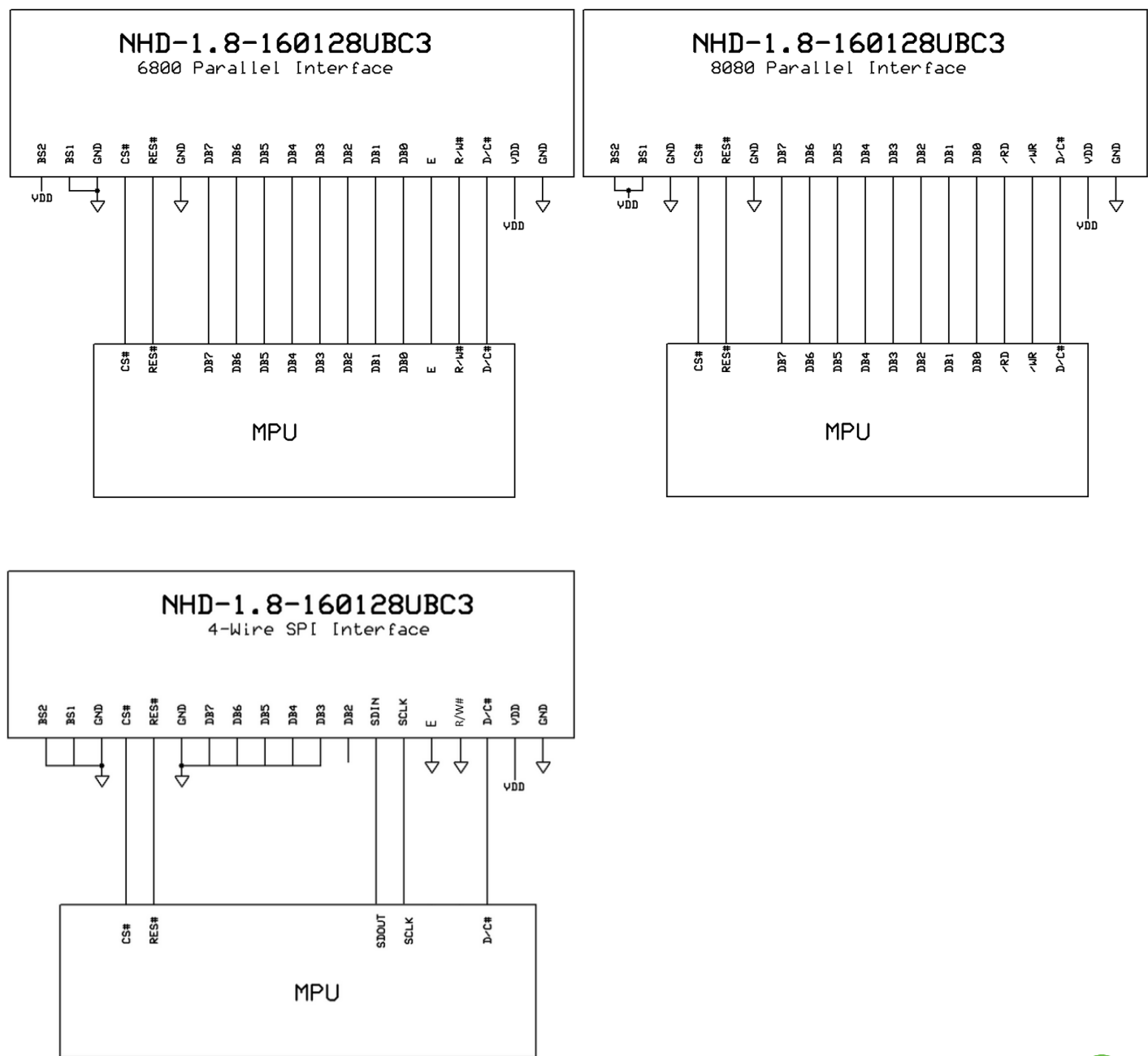
Interface Selection

MPU Interface Pin Selections and Assignment Summary

	6800 Parallel	8080 Parallel	4-Wire SPI
BS1	0	1	0
BS2	1	1	0

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#
4-wire SPI	Tie Low					NC	SDIN	SCLK	Tie Low		CS#	D/C#	RES#

Wiring Diagram



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	-	90	°C
Supply Voltage	V _{DD}	-	2.7	3.3	3.5	V
Supply Current	I _{DD}	V _{DD} =3.3V, 100% ON	-	200	250	mA
Sleep Mode Current	I _{DD_SLEEP}	V _{DD} = 3.3V	-	3	5	mA
"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

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	-	70	100	-	cd/m ²
Lifetime		-	70cd/m ² , T _{OP} =25°C, 50% Checkerboard	21,000	-	-	Hrs.
Chromaticity	Red	X _R	-	0.62	0.66	0.70	-
		Y _R	-	0.29	0.33	0.37	-
	Green	X _G	-	0.26	0.30	0.34	-
		Y _G	-	0.59	0.63	0.67	-
	Blue	X _B	-	0.10	0.14	0.18	-
		Y _B	-	0.14	0.18	0.22	-
	White	X _W	-	0.27	0.31	0.35	-
		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 SSD1353 Controller: <https://support.newhavendisplay.com/hc/en-us/articles/13264884302615-SSD1353>



Table of Commands

Fundamental Command Table											
D/C#	Hex	D7	D6	D5	D4	D3	D2	D1	D0	Command	Description
0 1 1	15 A[7:0] B[7:0]	0 A ₇ B ₇	0 A ₆ B ₆	0 A ₅ B ₅	1 A ₄ B ₄	0 A ₃ B ₃	1 A ₂ B ₂	0 A ₁ B ₁	1 A ₀ B ₀	Set Column Address	Set Column start and end address A[7:0]: Set start column address from 00d-159d [reset= 0d (00h)] B[7:0]: Set end column address from 00d-159d [reset= 159d (9Fh)]
0	5C	0	1	0	1	1	1	0	0	Write RAM Command	Enable MCU to write Data into RAM
0	5D	0	1	0	1	1	1	0	1	Read RAM Command	Enable MCU to read Data from RAM
0 1 1	75 A[7:0] B[7:0]	0 A ₇ B ₇	1 A ₆ B ₆	1 A ₅ B ₅	1 A ₄ B ₄	0 A ₃ B ₃	1 A ₂ B ₂	0 A ₁ B ₁	1 A ₀ B ₀	Set Row Address	Set Row start and end address A[7:0]: Set start row address from 00d-131d [reset= 0d (00h)] B[7:0]: Set end row address from 00d-131d [reset= 131d (83h)]
0 1	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 – SA159) A[7:0] valid range: 00d to 255d [reset=128d (80h)]
0 1	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 – SB159) A[7:0] valid range: 00d to 255d [reset=128d (80h)]
0 1	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 – SC159) A[7:0] valid range: 00d to 255d [reset=128d (80h)]
0 1	87 A[3:0]	1 *	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] can be set from 00d to 15d corresponding to 1/16, 2/16... to 16/16 attenuation. [reset= 15d (0Fh)]

Fundamental Command Table

D/C#	Hex	D7	D6	D5	D4	D3	D2	D1	D0	Command	Description
0 1	8A A[1:0]	1 0	0 0	0 0	0 0	1 0	0 0	1 A ₁	0 A ₀	Set Second Pre-charge speed	Set Second Pre-charge speed A[1:0]= 00b, Second Pre-charge speed =slowest A[1:0]= 01b, Second Pre-charge speed =slow A[1:0]= 10b, Second Pre-charge speed =normal [reset] A[1:0]= 11b, Second Pre-charge speed =Fast
0 1	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 [reset] A[0]=1, Vertical address increment A[1]=0, RAM Column 0 to 159 maps to Pin SEG (SA,SB,SC) 0 to 159 [reset] A[1]=1, RAM Column 0 to 159 maps to Pin SEG (SA,SB,SC) 159 to 0 A[2]=0, normal order SA,SB,SC (e.g. RGB) [reset] A[2]=1, reverse order SC,SB,SA (e.g. BGR) A[3]=0, Disable left-right swapping on COM [reset] A[3]=1, Set left-right swapping on COM A[4]=0, Scan from COM0 to COM[N-1] [reset] 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 Refer to Figure 10-5 for details. A[7:6] = 00; 256 color format A[7:6] = 01; 65k color format [RESET] A[7:6] = 10; 256k color format A[7:6] = 11; 256k color 16-bit format 2 If 9-/18-bit mode is selected, color depth will be fixed to 256k regardless of the setting. Refer to Table 8-7 for details.
0 1	A1 A[7:0]	1 A ₇	0 A ₆	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[7:0]: from 00d to 131d [reset = 0d (00h)] Note (1) A[7:0] must be set to 0 when using A3h command.
0 1	A2 A[7:0]	1 A ₇	0 A ₆	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[7:0]: from 00d to 131d [reset = 0d (00h)]
0 0 0 0	A4 A5 A6 A7	1 1 1 1	0 0 0 0	1 1 1 1	0 0 0 0	0 0 0 0	1 1 1 1	0 0 1 1	0 1 0 1	Set Display Mode	A4h=Normal Display [reset] A5h=Entire Display ON, all pixels turn ON at GS63 A6h=Entire Display OFF, all pixels turn OFF A7h=Inverse Display

Fundamental Command Table

D/C#	Hex	D7	D6	D5	D4	D3	D2	D1	D0	Command	Description																																		
0 1	A8 A[7:0]	1 A ₇	0 A ₆	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[7:0] from 15d to 131d (i.e.16MUX -132 MUX) A[7:0] from 00d to 14d are invalid entry [reset= 131d (83h)]																																		
0 1 1 1 1 1	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 A ₆ B ₆ C ₆ D ₆ *	1 A ₅ B ₅ C ₅ D ₅ *	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] = Pre-charge voltage setting, valid range 0 to 31d.																																		
0 0 0	AC AE AF	1 1 1	0 0 0	1 1 1	0 0 0	1 1 1	1 1 1	0 1 1	0 0 1	Set Display ON/OFF	ACh = Display ON in dim mode AEh = Display OFF (sleep mode) [reset] AFh = Display ON in normal mode Refer to Figure 10-12 for transitions between different modes																																		
0 1	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 DCLKs. 3~31 DCLKs allowed as follow: <table border="1"><tr><td>A[3:0]</td><td>Phase 1 period</td></tr><tr><td>0000</td><td>invalid</td></tr><tr><td>0001</td><td>3 DCLKs</td></tr><tr><td>0010</td><td>5 DCLKs</td></tr><tr><td>0011</td><td>7 DCLKs</td></tr><tr><td>0100</td><td>9 DCLKs [reset]</td></tr><tr><td>:</td><td>:</td></tr><tr><td>1111</td><td>31 DCLKs</td></tr></table> A[7:4] : Phase 2 period in N DCLKs. 2~15 DCLKs allowed. <table border="1"><tr><td>A[7:4]</td><td>Phase 2 period</td></tr><tr><td>0000</td><td>invalid</td></tr><tr><td>0001</td><td>invalid</td></tr><tr><td>0010</td><td>2 DCLKs</td></tr><tr><td>0011</td><td>3 DCLKs</td></tr><tr><td>:</td><td>:</td></tr><tr><td>0111</td><td>7 DCLKs[reset]</td></tr><tr><td>:</td><td>:</td></tr><tr><td>1111</td><td>15 DCLKs</td></tr></table>	A[3:0]	Phase 1 period	0000	invalid	0001	3 DCLKs	0010	5 DCLKs	0011	7 DCLKs	0100	9 DCLKs [reset]	:	:	1111	31 DCLKs	A[7:4]	Phase 2 period	0000	invalid	0001	invalid	0010	2 DCLKs	0011	3 DCLKs	:	:	0111	7 DCLKs[reset]	:	:	1111	15 DCLKs
A[3:0]	Phase 1 period																																												
0000	invalid																																												
0001	3 DCLKs																																												
0010	5 DCLKs																																												
0011	7 DCLKs																																												
0100	9 DCLKs [reset]																																												
:	:																																												
1111	31 DCLKs																																												
A[7:4]	Phase 2 period																																												
0000	invalid																																												
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0010	2 DCLKs																																												
0011	3 DCLKs																																												
:	:																																												
0111	7 DCLKs[reset]																																												
:	:																																												
1111	15 DCLKs																																												

Fundamental Command Table

D/C#	Hex	D7	D6	D5	D4	D3	D2	D1	D0	Command	Description
0 1	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] Divider DCLK is generated from CLK divided by DIVIDER +1 (i.e., 1 to 16) [reset=0000b] A[7:4] Fosc frequency Frequency increases as setting value increases [reset=1100b]
0 1	B4 A[3:0]	1 *	0 *	1 *	1 *	0 A ₃	1 A ₂	0 A ₁	0 A ₀	Set Second Pre-charge Period	A[3:0] Set Second Pre-charge Period 0000b 0 DCLKS 0001b 1 DCLKS 0010b 2 DCLKS 0111 7 DCLKS [reset] 1111 15 DCLKS
0 1 1 1 1 1 1 1 1 1 1 1	B8 A1[3:0] : A7[3:0] A8[4:0] : A15[4:0] A16[5:0] : A31[5:0] A32[6:0] : A63[6:0]	1 * : * * * * * * * * *	0 * : * * * * * * * * *	1 * : * * * * * * * * *	1 * : * * * * * * * * *	1 A ₁₃ : A ₇₃ A ₈₃ : A ₁₅₃ A ₁₆₃ : A ₃₁₃ A ₃₂₃ : A ₆₃₃	0 A ₁₂ : A ₇₂ A ₈₂ : A ₁₅₂ A ₁₆₂ : A ₃₁₂ A ₃₂₂ : A ₆₃₂	0 A ₁₁ : A ₇₁ A ₈₁ : A ₁₅₁ A ₁₆₁ : A ₃₁₁ A ₃₂₁ : A ₆₃₁	0 A ₁₀ : A ₇₀ A ₈₀ : A ₁₅₀ A ₁₆₀ : A ₃₁₀ A ₃₂₀ : A ₆₃₀	Set Gray Scale Table	These 63 parameters define Gray Scale (GS) Table in terms of Gamma Setting A1[3:0]: Gamma Setting for GS1, A2[3:0]: Gamma Setting for GS2, : A62[6:0]: Gamma Setting for GS62, A63[6:0]: Gamma Setting for GS63. Note 0 ¹ Input 1d for Gamma Setting 1, 2d for Gamma setting 2, ... ,127d for Gamma Setting 127 0 ² 0 < Setting of GS1 < Setting of GS2 < Setting of GS3..... Setting 62 < Setting 63 Refer to Section 8.8 for details.
0	B9	1	0	1	1	1	0	0	1	Enable Linear Gray Scale Table	Reset built in Linear Gray Scale table GS0 = Gamma Setting 0; GS1 = Gamma Setting 2 GS2 = Gamma Setting 4; GS3 = Gamma Setting 6; : GS31 = Gamma Setting 62 GS32 = Gamma Setting 65; GS33 = Gamma Setting 67; : GS62 = Gamma Setting 125; GS63 = Gamma Setting 127; Refer to Section 8.8 for details.

Fundamental Command Table

D/C#	Hex	D7	D6	D5	D4	D3	D2	D1	D0	Command	Description																					
0 1	BB A[5:1]	1 0	0 0	1 A ₅	1 A ₄	1 A ₃	0 A ₂	1 A ₁	1 0	Set Pre-charge level	Set pre-charge voltage level. All three colors share the same pre-charge voltage. [RESET =3Eh] <table><tr><th>A[5:1]</th><th>Hex code</th><th>pre-charge voltage</th></tr><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>0.55 x V_{CC}</td></tr></table>	A[5:1]	Hex code	pre-charge voltage	00000	00h	0.10 x V _{CC}	:	:	:	11111	3Eh	0.55 x V _{CC}									
A[5:1]	Hex code	pre-charge voltage																														
00000	00h	0.10 x V _{CC}																														
:	:	:																														
11111	3Eh	0.55 x V _{CC}																														
0 1	BE A[5:2]	1 0	0 0	1 A ₅	1 A ₄	1 A ₃	1 A ₂	1 0	0 0	Set V _{COMH}	Set COM deselect voltage level [reset =3Ch] A[5:2] = <table><tr><th>A[5:2]</th><th>Hex code</th><th>V_{COMH}</th></tr><tr><td>0000</td><td>00h</td><td>0.51 x V_{CC}</td></tr><tr><td>0001</td><td>04h</td><td>0.53 x V_{CC}</td></tr><tr><td>..</td><td>..</td><td>..</td></tr><tr><td>1101</td><td>34h</td><td>0.79 x V_{CC}</td></tr><tr><td>1110</td><td>38h</td><td>0.81 x V_{CC}</td></tr><tr><td>1111</td><td>3Ch</td><td>0.84 x V_{CC}</td></tr></table>	A[5:2]	Hex code	V _{COMH}	0000	00h	0.51 x V _{CC}	0001	04h	0.53 x V _{CC}	..	..	..	1101	34h	0.79 x V _{CC}	1110	38h	0.81 x V _{CC}	1111	3Ch	0.84 x V _{CC}
A[5:2]	Hex code	V _{COMH}																														
0000	00h	0.51 x V _{CC}																														
0001	04h	0.53 x V _{CC}																														
..	..	..																														
1101	34h	0.79 x V _{CC}																														
1110	38h	0.81 x V _{CC}																														
1111	3Ch	0.84 x V _{CC}																														
0 1 1	C0	1 CBTR3	1 CBTR2	0 CBTR1	0 CBTR0	0 CATR3	0 CATR2	0 CATR1	0 CATR0	OTP Write	Program data from MCU to OTP for color co-ordinate tuning. Details refer to section 10.1.22 “OTP Write (C0h)”.																					
0	E2	1	1	1	0	0	0	1	0	Software Reset	Reset display circuit and stop Graphic Acceleration operations.																					
0	E3	1	1	1	0	0	0	1	1	NOP	Command for no operation.																					
0 1	FD A[2]	1 0	1 0	1 0	1 1	1 0	1 A ₂	0 1	1 0	Set Command Lock	A[2]: MCU protection status [RESET = 12h] 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.																					

Graphic Acceleration Command Table

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[7:0] : Column Address of Start B[7:0] : Row Address of Start C[7:0] : Column Address of End D[7:0] : Row Address of End E[5:0] : Color C of the line F[5:0] : Color B of the line G[5:0] : Color A of the line
1	A[7:0]	A ₇	A ₆	A ₅	A ₄	A ₃	A ₂	A ₁	A ₀		
1	B[7:0]	B ₇	B ₆	B ₅	B ₄	B ₃	B ₂	B ₁	B ₀		
1	C[7:0]	C ₇	C ₆	C ₅	C ₄	C ₃	C ₂	C ₁	C ₀		
1	D[7:0]	D ₇	D ₆	D ₅	D ₄	D ₃	D ₂	D ₁	D ₀		
1	E[5:0]	*	*	E ₅	E ₄	E ₃	E ₂	E ₁	E ₀		
1	F[5:0]	*	*	F ₅	F ₄	F ₃	F ₂	F ₁	F ₀		
1	G[5:0]	*	*	G ₅	G ₄	G ₃	G ₂	G ₁	G ₀		
Note (1) Please enter all 6 bits for Color setting: E[5:0], F[5:0] and G[5:0] , despite of the color format setting in command A0h											
0	22	0	0	1	0	0	0	1	0	Drawing Rectangle	A[7:0] : Column Address of Start B[7:0] : Row Address of Start C[7:0] : Column Address of End D[7:0] : Row Address of End E[5:0] : Color C of the line F[5:0] : Color B of the line G[5:0] : Color A of the line H[5:0] : Color C of the fill area I[5:0] : Color B of the fill area J[5:0] : Color A of the fill area
1	A[7:0]	A ₇	A ₆	A ₅	A ₄	A ₃	A ₂	A ₁	A ₀		
1	B[7:0]	B ₇	B ₆	B ₅	B ₄	B ₃	B ₂	B ₁	B ₀		
1	C[7:0]	C ₇	C ₆	C ₅	C ₄	C ₃	C ₂	C ₁	C ₀		
1	D[7:0]	D ₇	D ₆	D ₅	D ₄	D ₃	D ₂	D ₁	D ₀		
1	E[5:0]	*	*	E ₅	E ₄	E ₃	E ₂	E ₁	E ₀		
1	F[5:0]	*	*	F ₅	F ₄	F ₃	F ₂	F ₁	F ₀		
1	G[5:0]	*	*	G ₅	G ₄	G ₃	G ₂	G ₁	G ₀		
1	H[5:0]	*	*	H ₅	H ₄	H ₃	H ₂	H ₁	H ₀		
1	I[5:0]	*	*	I ₅	I ₄	I ₃	I ₂	I ₁	I ₀		
1	J[5:0]	*	*	J ₅	J ₄	J ₃	J ₂	J ₁	J ₀		
Note (1) Please enter all 6 bits for Color setting: E[5:0], F[5:0] , G[5:0], H[5:0], I[5:0] and J[5:0] , despite of the color format setting in command A0h (2) 0<A[7:0] < C[7:0] <159 (3) 0<B[7:0] < D[7:0]<131											
0	23	0	0	1	0	0	0	1	1	Copy	A[7:0] : Column Address of Start B[7:0] : Row Address of Start C[7:0] : Column Address of End D[7:0] : Row Address of End E[7:0] : Column Address of New Start F[7:0] : Row Address of New Start
1	A[7:0]	A ₇	A ₆	A ₅	A ₄	A ₃	A ₂	A ₁	A ₀		
1	B[7:0]	B ₇	B ₆	B ₅	B ₄	B ₃	B ₂	B ₁	B ₀		
1	C[7:0]	C ₇	C ₆	C ₅	C ₄	C ₃	C ₂	C ₁	C ₀		
1	D[7:0]	D ₇	D ₆	D ₅	D ₄	D ₃	D ₂	D ₁	D ₀		
1	E[7:0]	E ₇	E ₆	E ₅	E ₄	E ₃	E ₂	E ₁	E ₀		
1	F[7:0]	F ₇	F ₆	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[7:0] : Column Address of Start B[7:0] : Row Address of Start C[7:0] : Column Address of End D[7:0] : Row Address of End The effect of dim window: GS15~GS0 no change GS19~GS16 become GS4 GS23~GS20 become GS5 ... GS63~GS60 become GS15
1	A[7:0]	A ₇	A ₆	A ₅	A ₄	A ₃	A ₂	A ₁	A ₀		
1	B[7:0]	B ₇	B ₆	B ₅	B ₄	B ₃	B ₂	B ₁	B ₀		
1	C[7:0]	C ₇	C ₆	C ₅	C ₄	C ₃	C ₂	C ₁	C ₀		
1	D[7:0]	D ₇	D ₆	D ₅	D ₄	D ₃	D ₂	D ₁	D ₀		

Graphic Acceleration Command Table

D/C#	Hex	D7	D6	D5	D4	D3	D2	D1	D0	Command	Description
0	25	0	0	1	0	0	1	0	1	Clear Window	A[7:0]: Column Address of Start
1	A[7:0]	A ₇	A ₆	A ₅	A ₄	A ₃	A ₂	A ₁	A ₀		B[7:0]: Row Address of Start
1	B[7:0]	B ₇	B ₆	B ₅	B ₄	B ₃	B ₂	B ₁	B ₀		C[7:0]: Column Address of End
1	C[7:0]	C ₇	C ₆	C ₅	C ₄	C ₃	C ₂	C ₁	C ₀		D[7:0]: Row Address of End
1	D[7:0]	D ₇	D ₆	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	A[0]:
1	A[4:0]	*	*	*	A ₄	0	0	0	A ₀		0b = Disable Fill for Draw Rectangle Command [reset] 1b = Enable Fill for Draw Rectangle Command A[3:1]: 000 (Reserved values) A[4]: 0b = Disable reverse copy (reset) 1b = Enable reverse during copy command.
0	27	0	0	1	0	0	1	1	1	Continuous Horizontal & Vertical Scrolling Setup	A[7:0]: Set number of column as horizontal scroll offset Range: 0d-131d (no horizontal scroll if equals to 0)
1	A[7:0]	A ₇	A ₆	A ₅	A ₄	A ₃	A ₂	A ₁	A ₀		B[7:0]: Define start row address
1	B[7:0]	B ₇	B ₆	B ₅	B ₄	B ₃	B ₂	B ₁	B ₀		C[7:0]: Set number of rows to be horizontal scrolled B[7:0]+C[7:0] <=132
1	C[7:0]	C ₇	C ₆	C ₅	C ₄	C ₃	C ₂	C ₁	C ₀		D[7:0]: Set number of row as vertical scroll offset Range: 0d-131d (no vertical scroll if equals to 0)
1	D[7:0]	D ₇	D ₆	D ₅	D ₄	D ₃	D ₂	D ₁	D ₀		E[1:0]: Set time interval between each scroll step 00b 3 frames 01b 5 frames 10b 50 frames 11b 100 frames
1	E[1:0]	*	*	*	*	*	*	E ₁	E ₀		Note: (1) Vertical scroll run with command A3h Set Vertical Scroll Area (2) The parameters should not be changed after scrolling is activated
0	2E	0	0	1	0	1	1	1	0	Deactivate horizontal scroll	Deactivate horizontal scrolling. Note (1) After sending 2Eh command to deactivate the scrolling action, the ram data needs to be rewritten.

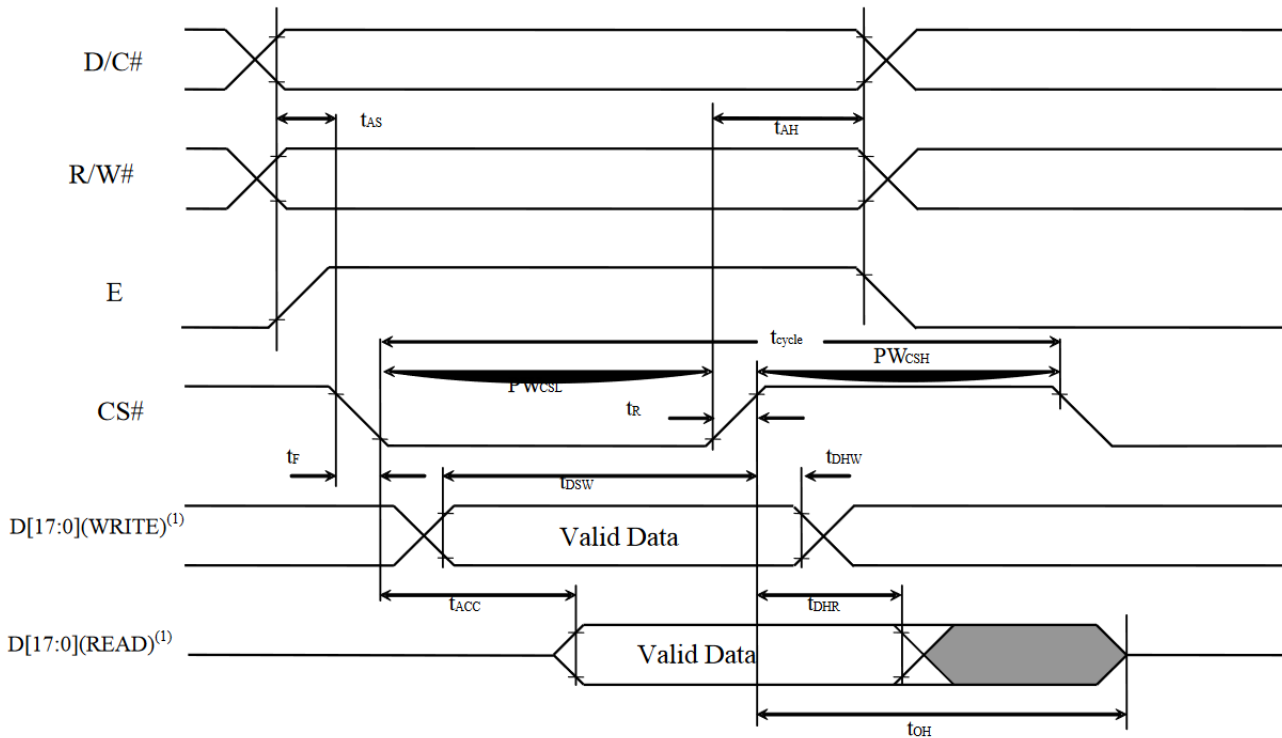
Graphic Acceleration Command Table											
D/C#	Hex	D7	D6	D5	D4	D3	D2	D1	D0	Command	Description
0	2F	0	0	1	0	1	1	1	1	Activate horizontal scroll	Activate horizontal scrolling. This command activates the scrolling function according to the setting done by command 27h Continuous Horizontal & Vertical Scrolling Setup
0 1 1	A3 A[7:0] B[7:0]	1 A ₇ B ₇	0 A ₆ B ₆	1 A ₅ B ₅	0 A ₄ B ₄	0 A ₃ B ₃	0 A ₂ B ₂	1 A ₁ B ₁	1 A ₀ B ₀	Set Vertical Scroll Area	A[7:0] : Set No. of rows in top fixed area. The No. of rows in top fixed area is referenced to the top of the GDDRAM (i.e. row 0). [RESET = 0] B[7:0] : Set No. of rows in scroll area. This is the number of rows to be used for vertical scrolling. The scroll area starts in the first row below the top fixed area. [RESET = 132] Note ⁽¹⁾ A[7:0]+B[7:0] <= MUX ratio ⁽²⁾ B[7:0] <= MUX ratio ⁽³⁾ Set Display Start Line (A1h) must be set to 0 when using A3h command. ⁽⁴⁾ The last row of the scroll area shifts to the first row of the scroll area. ⁽⁵⁾ For 132d MUX display A[7:0] = 0, B[7:0]=132 : whole area scrolls A[7:0]= 0, B[7:0] < 132 : top area scrolls A[7:0] + B[7:0] < 132 : central area scrolls A[7:0] + B[7:0] = 132 : bottom area scrolls Refer to Figure 10-20 for details.

Timing Characteristics

6800-Series MCU Parallel Interface:

($V_{DD} - V_{SS} = 2.4$ to $2.6V$, $V_{DDIO} = 1.6V$, $V_{CI} = 3.3V$, $T_A = 25^\circ C$)

Symbol	Parameter	Min	Typ	Max	Unit
t_{cycle}	Clock Cycle Time	300	-	-	ns
t_{AS}	Address Setup Time	0	-	-	ns
t_{AH}	Address Hold Time	0	-	-	ns
t_{DSW}	Write Data Setup Time	40	-	-	ns
t_{DHW}	Write Data Hold Time	7	-	-	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) Chip Select Low Pulse Width (write)	120 60	-	-	ns
PW_{CSH}	Chip Select High Pulse Width (read) Chip Select High Pulse Width (write)	60 60	-	-	ns
t_R	Rise Time	-	-	15	ns
t_F	Fall Time	-	-	15	ns



Note

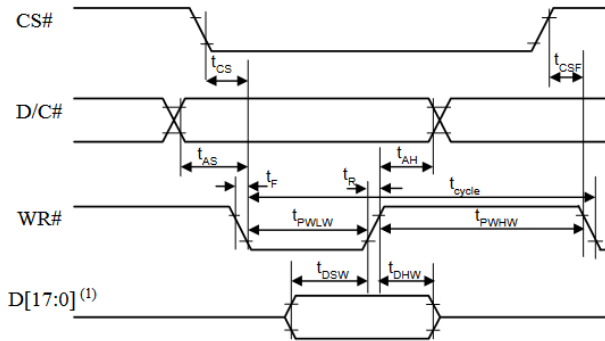
⁽¹⁾ when 8 bit used: D[7:0] instead; when 9 bit used: D[8:0] instead; when 16 bit used: [15:0] instead; when 18 bit used: D[17:0] instead.

8080-Series MCU Parallel Interface:

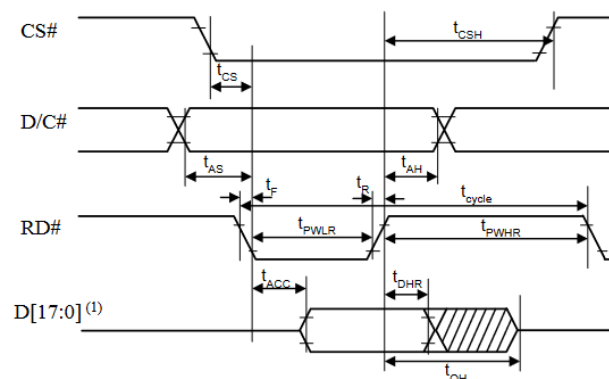
($V_{DD} - V_{SS} = 2.4$ to $2.6V$, $V_{DDIO}=1.6V$, $V_{CI} = 3.3V$, $T_A = 25^\circ C$)

Symbol	Parameter	Min	Typ	Max	Unit
t_{cycle}	Clock Cycle Time	300	-	-	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	7	-	-	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

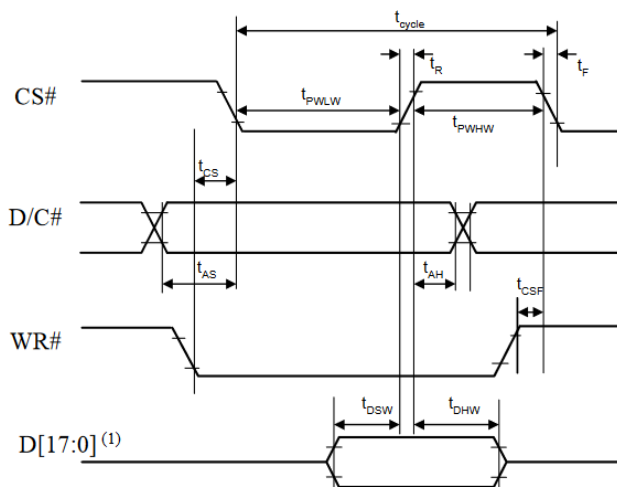
Write cycle (Form 1)



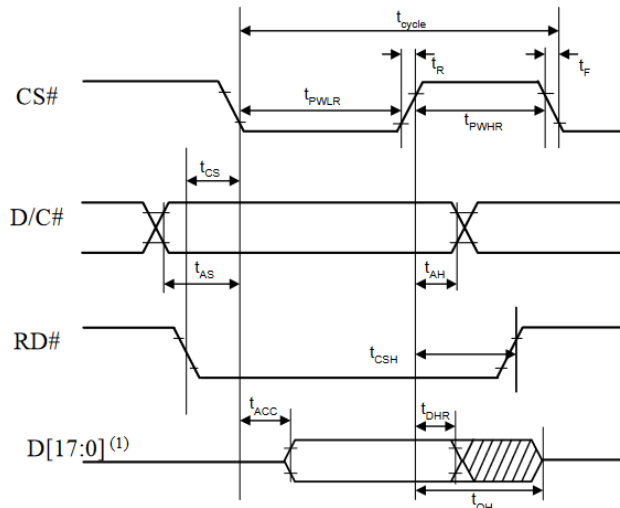
Read cycle (Form 1)



Write cycle (Form 2)



Read cycle (Form 2)



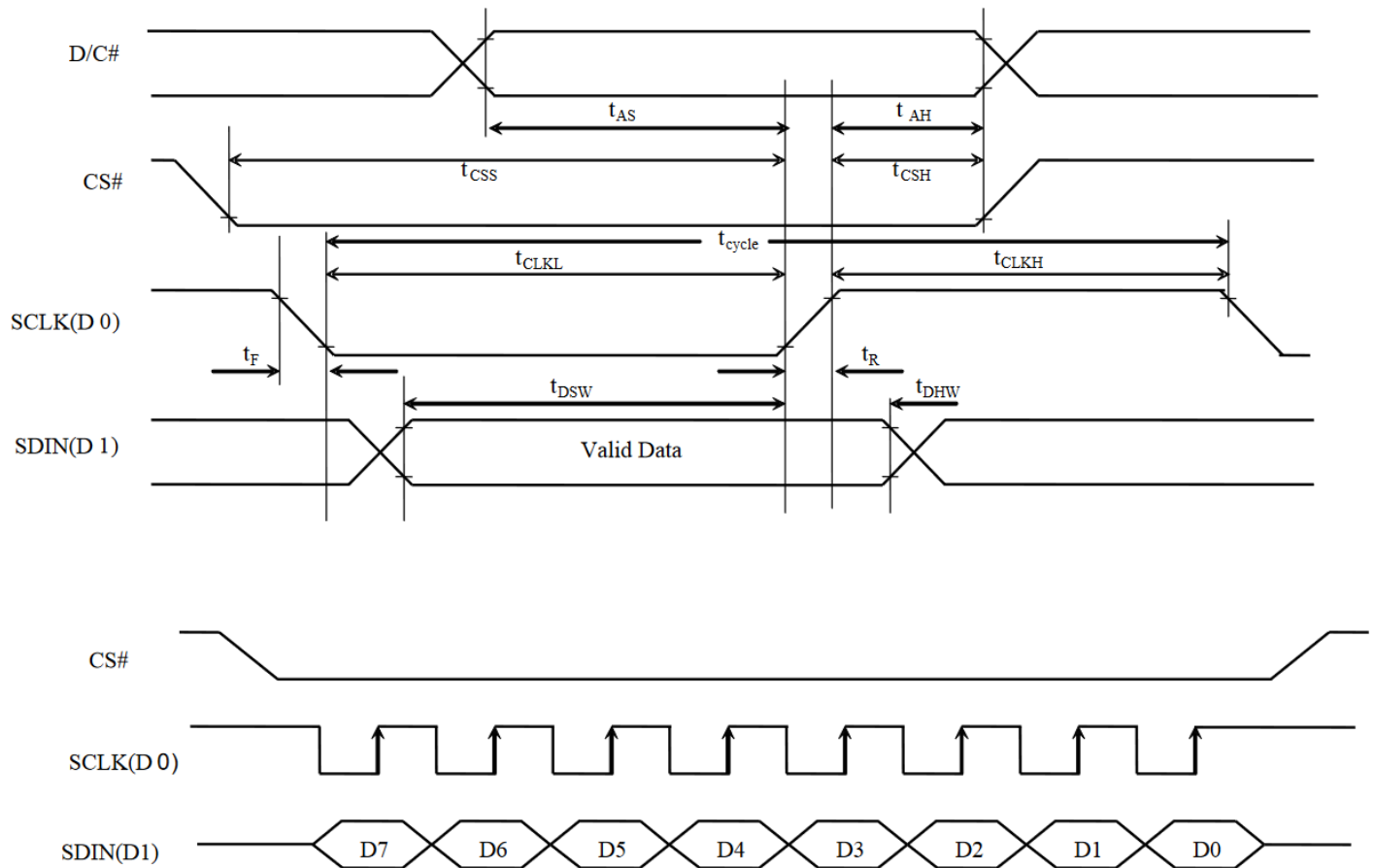
Note

⁽¹⁾ when 8 bit used: D[7:0] instead; when 9 bit used: D[8:0] instead; when 16 bit used: [15:0] instead; when 18 bit used: D[17:0] instead.

4-wire SPI:

($V_{DD} - V_{SS} = 2.4$ to $2.6V$, $V_{DDIO}=1.6V$, $V_{CI} = 3.3V$, $T_A = 25^{\circ}C$)

Symbol	Parameter	Min	Typ	Max	Unit
t_{cycle}	Clock Cycle Time	250	-	-	ns
t_{AS}	Address Setup Time	150	-	-	ns
t_{AH}	Address Hold Time	150	-	-	ns
t_{CSS}	Chip Select Setup Time	120	-	-	ns
t_{CSH}	Chip Select Hold Time	60	-	-	ns
t_{DSW}	Write Data Setup Time	100	-	-	ns
t_{DHW}	Write Data Hold Time	100	-	-	ns
t_{CLKL}	Clock Low Time	100	-	-	ns
t_{CLKH}	Clock High Time	100	-	-	ns
t_R	Rise Time	-	-	15	ns
t_F	Fall Time	-	-	15	ns



Example Initialization Sequence

```
void Init_OLED()
{
    command(0xAE); //Set Display OFF
    command(0xA8); //Set MUX ratio
    data(0x7F); //
    command(0xA2); //Set Display offset
    data(0x00);
    command(0xA1); //Set display start line
    data(0x00);
    command(0xA4); //Normal display
    command(0xA0); //Set Re-map, color depth
    data(0x64); //
    command(0x81); //Set Contrast for color"A" segment
    data(0x75); //Red contrast set for VCC:17V
    command(0x82); //Set Contrast for color"B" segment
    data(0x60); //Green contrast set for VCC:17V
    command(0x83); //Set Contrast for color"C" segment
    data(0x6A); //Blue contrast set for VCC:17V
    command(0x87); //Master Contrast Current Control
    data(0x0F); //reset value for VCC:17V
    command(0xB9); //use linear grayscale table
    command(0xB1); //Set Phase1 and phase2 period adjustment
    data(0x22);
    command(0xB3); //Set Display Clock Divide Ratio (internal clock selection)
    data(0x40);
    command(0xBB); //Set Pre-charge Voltage
    data(0x08);
    command(0xBE); //Set VCOMH
    data(0x2F);
    command(0xAF); //Set Display ON in normal mode
}
```

Quality Information

Test Item	Content of Test	Test Condition	Note
High Temperature storage	Test the endurance of the display at high storage temperature.	90°C, 240hrs	2
Low Temperature storage	Test the endurance of the display at low storage temperature.	-40°C, 240hrs	1,2
High Temperature Operation	Test the endurance of the display by applying electric stress (voltage & current) at high temperature.	85°C, 240hrs	2
Low Temperature Operation	Test the endurance of the display by applying electric stress (voltage & current) at low temperature.	-40°C, 240hrs	1,2
High Temperature / Humidity Operation	Test the endurance of the display by applying electric stress (voltage & current) at high temperature with high humidity.	+65°C, 90% RH, 96hrs	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, 30min-> 85°C,30min = 1 cycle 20 cycles	
Vibration test	Test the endurance of the display by applying vibration to simulate transportation and use.	5-50Hz, 0.5G 2hrs in each of 3 directions X,Y,Z	3
Static electricity test	Test the endurance of the display by applying electric static discharge.	Air discharge ±8kV 10 times	

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.