

**Product Specification**

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# NHD-1.8-160128B

## Graphic Color OLED Display

<b>NHD-</b>	Newhaven Display
<b>1.8-</b>	1.8" Diagonal Size
<b>160128-</b>	160 x 128 Pixels
<b>B-</b>	Model

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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

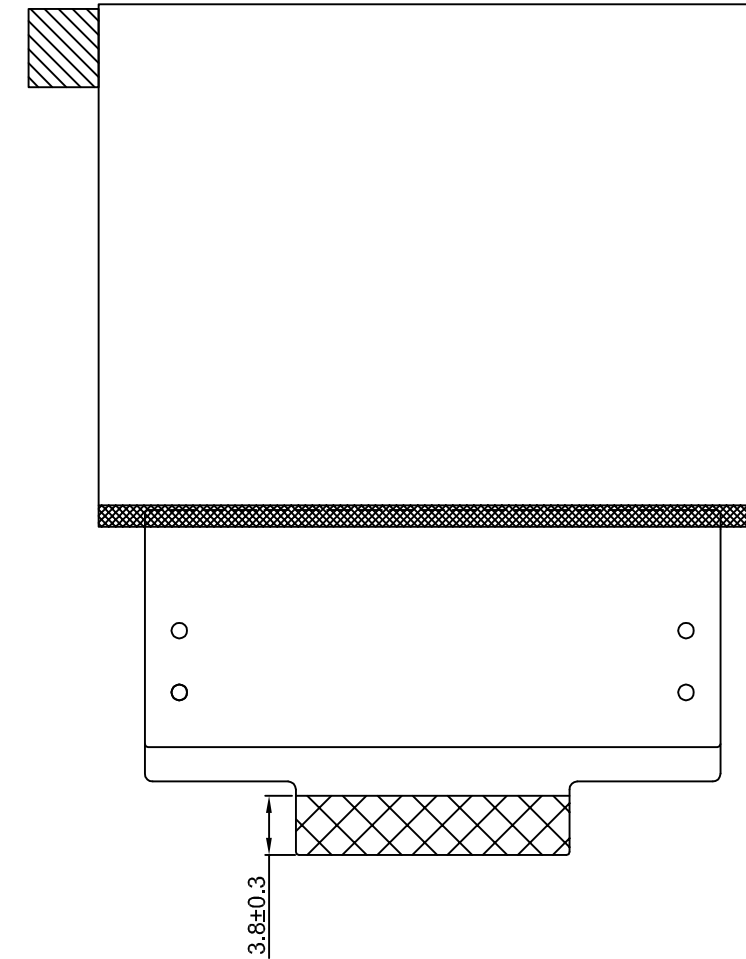
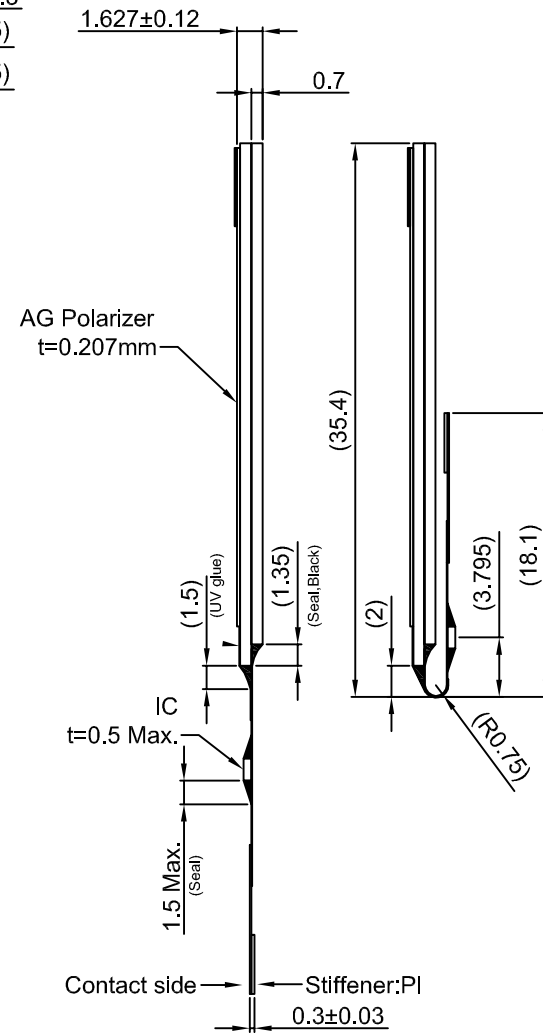
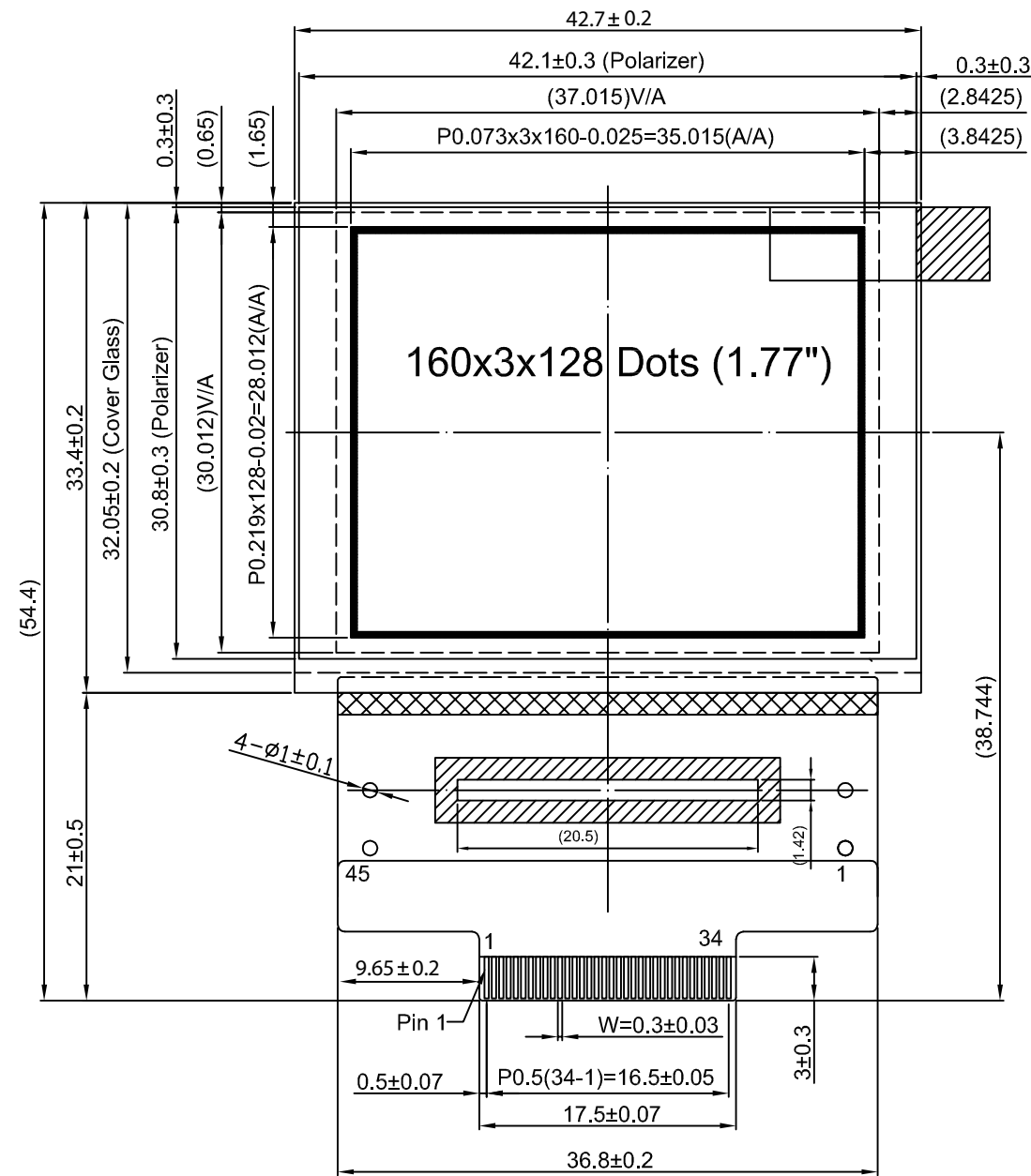
Revision	Date	Description	Changed By
-	01/02/2024	Initial Release	KL

# Mechanical Drawing

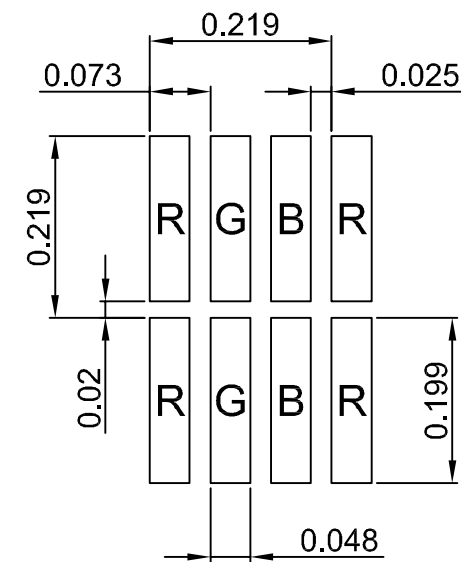
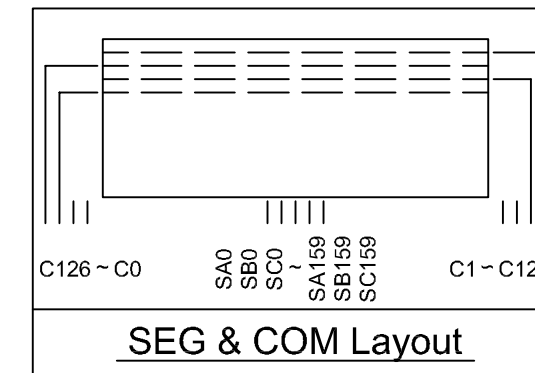
Newhaven Display

NHD-1.8-160128B  
Date Code

Part Label (type/format may vary)



Pin Assignment	
NO.	SYMBOL
1	NC
2	VCC
3	VCOMH
4	VLSS
5	VSS
6	VBREF
7	VSL
8	VCI
9	VPP
10	VDD
11	VDDIO
12	REGVDD
13	BS1
14	BS2
15	FR
16	CS#
17	RES#
18	D/C#
19	R/W#(WR#)
20	E(RD#)
21	D0
22	D1
23	D2
24	D3
25	D4
26	D5
27	D6
28	D7
29	IREF
30	VSS
31	VLSS
32	VCOMH
33	VCC
34	NC



Product Description: 1.8" 160x128 Color OLED

1. Driver IC: SSD1353
2. Interface: 8-bit 6800/8080 Parallel, 4-wire SPI
3. Power Requirement: 2.8V OLED
4. Optical Features: Full Color, Full View
5. Recommended FFC Connector: 34pin 0.5mm pitch; Ex. Molex 54104-3431

<b>Standard Tolerance:</b> (Unless otherwise specified)  Linear: ±0.3mm		
	Drawing/Part Number: <b>NHD-1.8-160128B</b>	Revision: 1A
<b>Unless otherwise specified:</b> • Dimensions are in Millimeters • Third Angle Projection	Drawn By: K. Lewis Drawn Date: 01/02/2024	Approved By: K. Lewis Approved Date: 01/02/2024
This drawing is solely the property of Newhaven Display International, Inc. The information it contains is not to be disclosed, reproduced or copied in whole or part without written approval from Newhaven Display.		

## Pin Description

Pin No.	Symbol	External Connection	Function Description
1	NC	-	No Connect
2	V <sub>CC</sub>	Power Supply	Supply Voltage for Display (17V)
3	V <sub>COMH</sub>	Power Supply	Voltage for High Level COM Signal
4	V <sub>LSS</sub>	Power Supply	Ground
5	V <sub>SS</sub>	Power Supply	Ground
6	V <sub>BREF</sub>	Power Supply	Internal Voltage reference signal
7	V <sub>SL</sub>	Power Supply	Voltage for Low Level SEG signal
8	V <sub>CI</sub>	Power Supply	Supply Voltage for operation (2.8V)
9	V <sub>PP</sub>	Power Supply	Connect to V <sub>DD</sub>
10	V <sub>DD</sub>	Power Supply	Supply Voltage for Logic
11	V <sub>DDIO</sub>	Power Supply	Supply Voltage for I/O pins
12	REGVDD	Power Supply	Internal VDD regulator selection pin. When this pin is pulled HIGH, internal V <sub>DD</sub> regulator is enabled. When this pin is pulled LOW, external V <sub>DD</sub> is used.
13	BS1	MPU	MPU Interface Select signal
14	BS2	MPU	MPU Interface Select signal
15	FR	MPU	RAM write synchronization signal (No Connect if not used)
16	CS#	MPU	Active LOW Chip Select signal
17	RES#	MPU	Active LOW Reset signal
18	DC#	MPU	Data/Command Control signal. HIGH: Data, LOW: Command
19	R/W# (WR#)	MPU	<b>6800 mode:</b> Read/Write signal. High: Read, LOW: Write <b>8080 mode:</b> Active LOW Write signal
20	E (RD#)	MPU	<b>6800 mode:</b> Enable signal. Falling edge triggered <b>8080 mode:</b> Active LOW Read signal
21-28	D0-D7	MPU	<b>Parallel Interface:</b> 8-bit Bi-directional data bus <b>4-wire SPI Interface:</b> D0-Serial Clock signal (SCLK) D1-Serial Data Input signal (SDIN) D2-No connect
29	IREF	-	Current for SEG Brightness
30	V <sub>SS</sub>	Power Supply	Ground
31	V <sub>LSS</sub>	Power Supply	Ground
32	V <sub>COMH</sub>	Power Supply	Voltage for High Level COM signal
33	V <sub>CC</sub>	Power Supply	Supply Voltage for Display (17V)
34	NC	-	No Connect

**Recommended display connector:** 34pin 0.5mm pitch top contact FFC connector



# Interface Selection

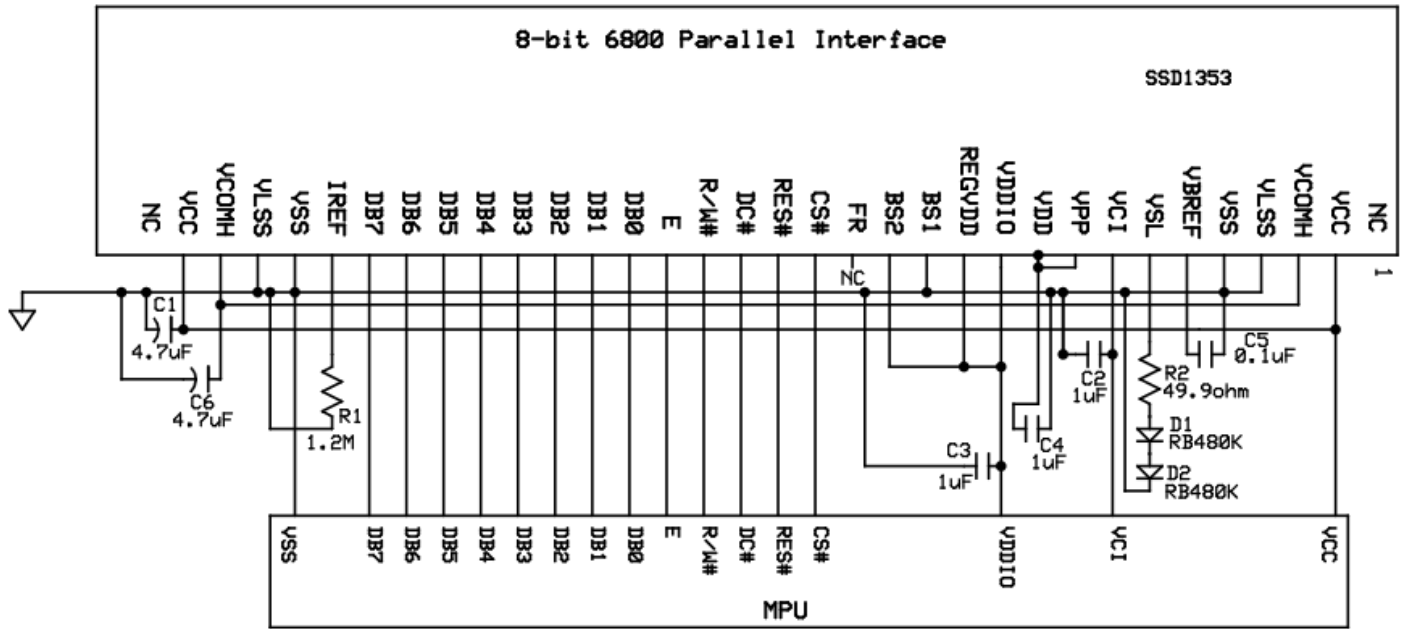
## MPU Interface Pin Selections and Assignment Summary

	6800 Parallel	8080 Parallel	4-Wire SPI	I <sup>2</sup> C
BS1	0	1	0	1
BS2	1	1	0	0

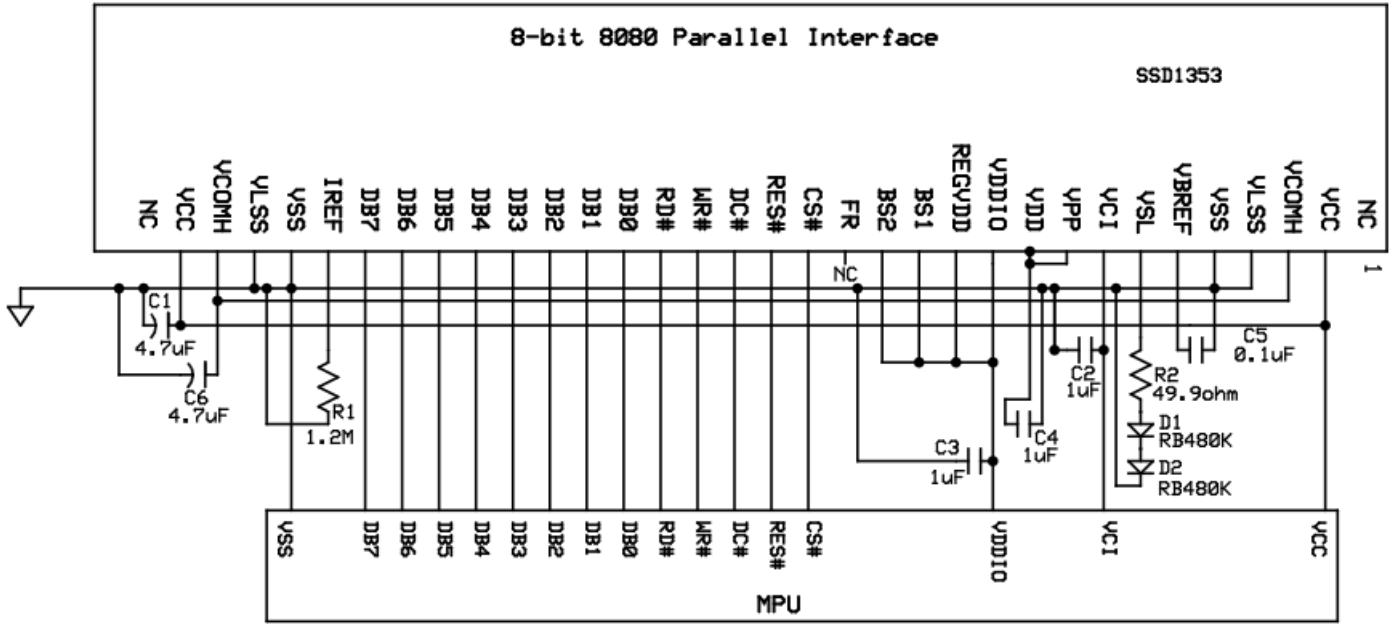
Bus Interface	Data/Command Interface								Control Signals				
	D7	D6	D5	D4	D3	D2	D1	D0	E	R/W#	CS#	D/C#	RES#
8-bit 6800	D[7:0]								E	R/W#	CS#	D/C#	RES#
8-bit 8080	D[7:0]								RD#	WR#	CS#	D/C#	RES#
SPI	Tie Low				NC	SDIN	SCLK	Tie Low		CS#	D/C#	RES#	

# Wiring Diagram

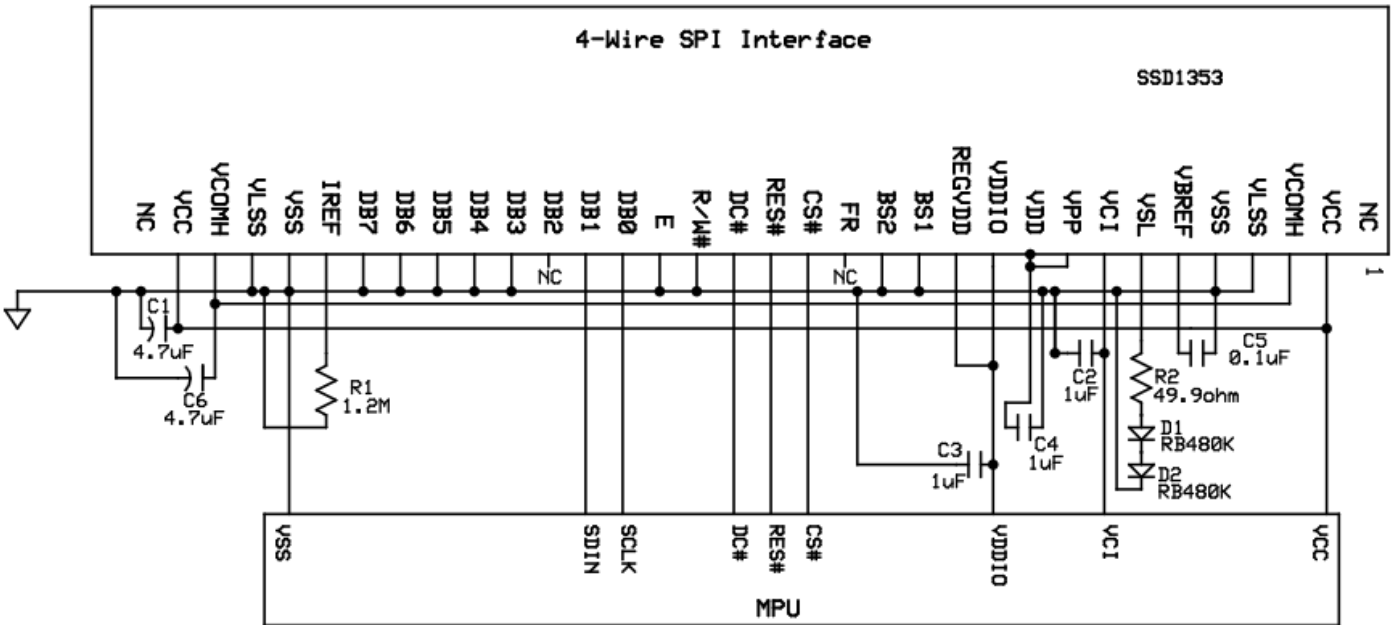
## 6800 Parallel Interface



**8080 Parallel Interface**



**SPI Interface**



## Electrical Characteristics

Item	Symbol	Condition	Min.	Typ.	Max.	Unit
Operating Temperature Range	T <sub>OP</sub>	Absolute Max	-40	-	+70	°C
Storage Temperature Range	T <sub>ST</sub>	Absolute Max	-40	-	+85	°C
Supply Voltage for Logic	V <sub>DD</sub>	-	2.4	2.5	2.6	V
Supply Voltage for I/O pins	V <sub>DDIO</sub>	-	1.6	1.8	3.5	V
Supply Voltage for Operation	V <sub>CI</sub>	-	2.4	2.8	3.5	V
Supply Voltage for Display	V <sub>CC</sub>	-	16.5	17	17.5	V
Supply Current for Display	I <sub>CC</sub>	V <sub>CC</sub> =17V, 100% ON	-	39	41	mA
Sleep Mode Current	I <sub>CC_sleep</sub>	V <sub>CI</sub> = 2.8V	-	3	5	mA
"H" Level input	V <sub>IH</sub>	-	0.8*V <sub>DDIO</sub>	-	V <sub>DDIO</sub>	V
"L" Level input	V <sub>IL</sub>	-	V <sub>SS</sub>	-	0.2*V <sub>DDIO</sub>	V
"H" Level output	V <sub>OH</sub>	-	0.9*V <sub>DDIO</sub>	-	V <sub>DDIO</sub>	V
"L" Level output	V <sub>OL</sub>	-	V <sub>SS</sub>	-	0.1*V <sub>DDIO</sub>	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 <sub>R</sub>	-	-	10	-	us
	Fall	T <sub>F</sub>	-	-	10	-	us
Brightness		L <sub>V</sub>	-	70	100	-	cd/m <sup>2</sup>
Lifetime			70cd/m <sup>2</sup> , T <sub>OP</sub> =25°C 50% Checkerboard	21,000	-	-	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 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	15	0	0	0	1	0	1	0	1	Set Column Address	Set Column start and end address
1	A[7:0]	A <sub>7</sub>	A <sub>6</sub>	A <sub>5</sub>	A <sub>4</sub>	A <sub>3</sub>	A <sub>2</sub>	A <sub>1</sub>	A <sub>0</sub>		A[7:0]: Set start column address from 00d-159d [reset= 0d (00h)]
1	B[7:0]	B <sub>7</sub>	B <sub>6</sub>	B <sub>5</sub>	B <sub>4</sub>	B <sub>3</sub>	B <sub>2</sub>	B <sub>1</sub>	B <sub>0</sub>		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	75	0	1	1	1	0	1	0	1	Set Row Address	Set Row start and end address
1	A[7:0]	A <sub>7</sub>	A <sub>6</sub>	A <sub>5</sub>	A <sub>4</sub>	A <sub>3</sub>	A <sub>2</sub>	A <sub>1</sub>	A <sub>0</sub>		A[7:0]: Set start row address from 00d-131d [reset= 0d (00h)]
1	B[7:0]	B <sub>7</sub>	B <sub>6</sub>	B <sub>5</sub>	B <sub>4</sub>	B <sub>3</sub>	B <sub>2</sub>	B <sub>1</sub>	B <sub>0</sub>		B[7:0]: Set end row address from 00d-131d [reset= 131d (83h)]
0	81	1	0	0	0	0	0	0	1	Set Contrast for Color "A"	Set contrast for all color "A" segment (Pins :SA0 – SA159)
1	A[7:0]	A <sub>7</sub>	A <sub>6</sub>	A <sub>5</sub>	A <sub>4</sub>	A <sub>3</sub>	A <sub>2</sub>	A <sub>1</sub>	A <sub>0</sub>		A[7:0] valid range: 00d to 255d [reset=128d (80h)]
0	82	1	0	0	0	0	0	1	0	Set Contrast for Color "B"	Set contrast for all color "B" segment (Pins :SB0 – SB159)
1	A[7:0]	A <sub>7</sub>	A <sub>6</sub>	A <sub>5</sub>	A <sub>4</sub>	A <sub>3</sub>	A <sub>2</sub>	A <sub>1</sub>	A <sub>0</sub>		A[7:0] valid range: 00d to 255d [reset=128d (80h)]
0	83	1	0	0	0	0	0	1	1	Set Contrast for Color "C"	Set contrast for all color "C" segment (Pins :SC0 – SC159)
1	A[7:0]	A <sub>7</sub>	A <sub>6</sub>	A <sub>5</sub>	A <sub>4</sub>	A <sub>3</sub>	A <sub>2</sub>	A <sub>1</sub>	A <sub>0</sub>		A[7:0] valid range: 00d to 255d [reset=128d (80h)]
0	87	1	0	0	0	0	1	1	1	Master Current Control	Set master current attenuation factor
1	A[3:0]	*	*	*	*	A <sub>3</sub>	A <sub>2</sub>	A <sub>1</sub>	A <sub>0</sub>		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										Command	Description
D/C#	Hex	D7	D6	D5	D4	D3	D2	D1	D0		
0 1	8A A[1:0]	1 0	0 0	0 0	0 0	1 0	0 0	1 A <sub>1</sub>	0 A <sub>0</sub>		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 <sub>7</sub>	0 A <sub>6</sub>	1 A <sub>5</sub>	0 A <sub>4</sub>	0 A <sub>3</sub>	0 A <sub>2</sub>	0 A <sub>1</sub>	0 A <sub>0</sub>		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 <sub>7</sub>	0 A <sub>6</sub>	1 A <sub>5</sub>	0 A <sub>4</sub>	0 A <sub>3</sub>	0 A <sub>2</sub>	0 A <sub>1</sub>	1 A <sub>0</sub>		Set display start line register by Row A[7:0]: from 00d to 131d [reset = 0d (00h)]  <b>Note</b> <sup>(1)</sup> A[7:0] must be set to 0 when using A3h command.
0 1	A2 A[7:0]	1 A <sub>7</sub>	0 A <sub>6</sub>	1 A <sub>5</sub>	0 A <sub>4</sub>	0 A <sub>3</sub>	0 A <sub>2</sub>	1 A <sub>1</sub>	0 A <sub>0</sub>		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 <sub>7</sub>	0 A <sub>6</sub>	1 A <sub>5</sub>	0 A <sub>4</sub>	1 A <sub>3</sub>	0 A <sub>2</sub>	0 A <sub>1</sub>	0 A <sub>0</sub>	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	AB A[7:0] B[7:0] C[7:0] D[7:0] E[4:0]	1 A <sub>7</sub> B <sub>7</sub> C <sub>7</sub> D <sub>7</sub> *	0 A <sub>6</sub> B <sub>6</sub> C <sub>6</sub> D <sub>6</sub> *	1 A <sub>5</sub> B <sub>5</sub> C <sub>5</sub> D <sub>5</sub> *	0 A <sub>4</sub> B <sub>4</sub> C <sub>4</sub> D <sub>4</sub> E <sub>4</sub>	1 A <sub>3</sub> B <sub>3</sub> C <sub>3</sub> D <sub>3</sub> E <sub>3</sub>	0 A <sub>2</sub> B <sub>2</sub> C <sub>2</sub> D <sub>2</sub> E <sub>2</sub>	1 A <sub>1</sub> B <sub>1</sub> C <sub>1</sub> D <sub>1</sub> E <sub>1</sub>	1 A <sub>0</sub> B <sub>0</sub> C <sub>0</sub> D <sub>0</sub> E <sub>0</sub>	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 <sub>7</sub>	0 A <sub>6</sub>	1 A <sub>5</sub>	1 A <sub>4</sub>	0 A <sub>3</sub>	0 A <sub>2</sub>	0 A <sub>1</sub>	1 A <sub>0</sub>	Phase 1 and 2 period adjustment	A[3:0] : Phase 1 period in N DCLKs. 3~31 DCLKs allowed as follow: <table border="1" data-bbox="1023 1129 1302 1360"> <thead> <tr> <th>A[3:0]</th> <th>Phase 1 period</th> </tr> </thead> <tbody> <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> </tbody> </table> A[7:4] : Phase 2 period in N DCLKs. 2~15 DCLKs allowed. <table border="1" data-bbox="1023 1499 1302 1759"> <thead> <tr> <th>A[7:4]</th> <th>Phase 2 period</th> </tr> </thead> <tbody> <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> </tbody> </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																																												
0001	invalid																																												
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	BB A[5:1]	1 0	0 0	1 A <sub>5</sub>	1 A <sub>4</sub>	1 A <sub>3</sub>	0 A <sub>2</sub>	1 A <sub>1</sub>	1 0	Set Pre-charge level	Set pre-charge voltage level. All three colors share the same pre-charge voltage. [RESET =3Eh]  <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<sub>CC</sub></td> </tr> <tr> <td>:</td> <td>:</td> <td>:</td> </tr> <tr> <td>11111</td> <td>3Eh</td> <td>0.55 x V<sub>CC</sub></td> </tr> </tbody> </table>	A[5:1]	Hex code	pre-charge voltage	00000	00h	0.10 x V <sub>CC</sub>	:	:	:	11111	3Eh	0.55 x V <sub>CC</sub>									
A[5:1]	Hex code	pre-charge voltage																														
00000	00h	0.10 x V <sub>CC</sub>																														
:	:	:																														
11111	3Eh	0.55 x V <sub>CC</sub>																														
0 1	BE A[5:2]	1 0	0 0	1 A <sub>5</sub>	1 A <sub>4</sub>	1 A <sub>3</sub>	1 A <sub>2</sub>	1 0	0 0	Set V <sub>COMH</sub>	Set COM deselect voltage level [reset =3Ch] A[5:2] =  <table border="1"> <thead> <tr> <th>A[5:2]</th> <th>Hex code</th> <th>V<sub>COMH</sub></th> </tr> </thead> <tbody> <tr> <td>0000</td> <td>00h</td> <td>0.51 x V<sub>CC</sub></td> </tr> <tr> <td>0001</td> <td>04h</td> <td>0.53 x V<sub>CC</sub></td> </tr> <tr> <td>..</td> <td>..</td> <td>..</td> </tr> <tr> <td>1101</td> <td>34h</td> <td>0.79 x V<sub>CC</sub></td> </tr> <tr> <td>1110</td> <td>38h</td> <td>0.81 x V<sub>CC</sub></td> </tr> <tr> <td>1111</td> <td>3Ch</td> <td>0.84 x V<sub>CC</sub></td> </tr> </tbody> </table>	A[5:2]	Hex code	V <sub>COMH</sub>	0000	00h	0.51 x V <sub>CC</sub>	0001	04h	0.53 x V <sub>CC</sub>	..	..	..	1101	34h	0.79 x V <sub>CC</sub>	1110	38h	0.81 x V <sub>CC</sub>	1111	3Ch	0.84 x V <sub>CC</sub>
A[5:2]	Hex code	V <sub>COMH</sub>																														
0000	00h	0.51 x V <sub>CC</sub>																														
0001	04h	0.53 x V <sub>CC</sub>																														
..	..	..																														
1101	34h	0.79 x V <sub>CC</sub>																														
1110	38h	0.81 x V <sub>CC</sub>																														
1111	3Ch	0.84 x V <sub>CC</sub>																														
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 coordinate 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 <sub>2</sub>	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  <b>Note</b> <sup>0)</sup> 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 <sub>7</sub>	A <sub>6</sub>	A <sub>5</sub>	A <sub>4</sub>	A <sub>3</sub>	A <sub>2</sub>	A <sub>1</sub>	A <sub>0</sub>		
1	B[7:0]	B <sub>7</sub>	B <sub>6</sub>	B <sub>5</sub>	B <sub>4</sub>	B <sub>3</sub>	B <sub>2</sub>	B <sub>1</sub>	B <sub>0</sub>		
1	C[7:0]	C <sub>7</sub>	C <sub>6</sub>	C <sub>5</sub>	C <sub>4</sub>	C <sub>3</sub>	C <sub>2</sub>	C <sub>1</sub>	C <sub>0</sub>		
1	D[7:0]	D <sub>7</sub>	D <sub>6</sub>	D <sub>5</sub>	D <sub>4</sub>	D <sub>3</sub>	D <sub>2</sub>	D <sub>1</sub>	D <sub>0</sub>		
1	E[5:0]	*	*	E <sub>5</sub>	E <sub>4</sub>	E <sub>3</sub>	E <sub>2</sub>	E <sub>1</sub>	E <sub>0</sub>		
1	F[5:0]	*	*	F <sub>5</sub>	F <sub>4</sub>	F <sub>3</sub>	F <sub>2</sub>	F <sub>1</sub>	F <sub>0</sub>		
1	G[5:0]	*	*	G <sub>5</sub>	G <sub>4</sub>	G <sub>3</sub>	G <sub>2</sub>	G <sub>1</sub>	G <sub>0</sub>		
											<b>Note</b> (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 <sub>7</sub>	A <sub>6</sub>	A <sub>5</sub>	A <sub>4</sub>	A <sub>3</sub>	A <sub>2</sub>	A <sub>1</sub>	A <sub>0</sub>		
1	B[7:0]	B <sub>7</sub>	B <sub>6</sub>	B <sub>5</sub>	B <sub>4</sub>	B <sub>3</sub>	B <sub>2</sub>	B <sub>1</sub>	B <sub>0</sub>		
1	C[7:0]	C <sub>7</sub>	C <sub>6</sub>	C <sub>5</sub>	C <sub>4</sub>	C <sub>3</sub>	C <sub>2</sub>	C <sub>1</sub>	C <sub>0</sub>		
1	D[7:0]	D <sub>7</sub>	D <sub>6</sub>	D <sub>5</sub>	D <sub>4</sub>	D <sub>3</sub>	D <sub>2</sub>	D <sub>1</sub>	D <sub>0</sub>		
1	E[5:0]	*	*	E <sub>5</sub>	E <sub>4</sub>	E <sub>3</sub>	E <sub>2</sub>	E <sub>1</sub>	E <sub>0</sub>		
1	F[5:0]	*	*	F <sub>5</sub>	F <sub>4</sub>	F <sub>3</sub>	F <sub>2</sub>	F <sub>1</sub>	F <sub>0</sub>		
1	G[5:0]	*	*	G <sub>5</sub>	G <sub>4</sub>	G <sub>3</sub>	G <sub>2</sub>	G <sub>1</sub>	G <sub>0</sub>		
1	H[5:0]	*	*	H <sub>5</sub>	H <sub>4</sub>	H <sub>3</sub>	H <sub>2</sub>	H <sub>1</sub>	H <sub>0</sub>		
1	I[5:0]	*	*	I <sub>5</sub>	I <sub>4</sub>	I <sub>3</sub>	I <sub>2</sub>	I <sub>1</sub>	I <sub>0</sub>		
1	J[5:0]	*	*	J <sub>5</sub>	J <sub>4</sub>	J <sub>3</sub>	J <sub>2</sub>	J <sub>1</sub>	J <sub>0</sub>		
											<b>Note</b> (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 <sub>7</sub>	A <sub>6</sub>	A <sub>5</sub>	A <sub>4</sub>	A <sub>3</sub>	A <sub>2</sub>	A <sub>1</sub>	A <sub>0</sub>		
1	B[7:0]	B <sub>7</sub>	B <sub>6</sub>	B <sub>5</sub>	B <sub>4</sub>	B <sub>3</sub>	B <sub>2</sub>	B <sub>1</sub>	B <sub>0</sub>		
1	C[7:0]	C <sub>7</sub>	C <sub>6</sub>	C <sub>5</sub>	C <sub>4</sub>	C <sub>3</sub>	C <sub>2</sub>	C <sub>1</sub>	C <sub>0</sub>		
1	D[7:0]	D <sub>7</sub>	D <sub>6</sub>	D <sub>5</sub>	D <sub>4</sub>	D <sub>3</sub>	D <sub>2</sub>	D <sub>1</sub>	D <sub>0</sub>		
1	E[7:0]	E <sub>7</sub>	E <sub>6</sub>	E <sub>5</sub>	E <sub>4</sub>	E <sub>3</sub>	E <sub>2</sub>	E <sub>1</sub>	E <sub>0</sub>		
1	F[7:0]	F <sub>7</sub>	F <sub>6</sub>	F <sub>5</sub>	F <sub>4</sub>	F <sub>3</sub>	F <sub>2</sub>	F <sub>1</sub>	F <sub>0</sub>		
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 <sub>7</sub>	A <sub>6</sub>	A <sub>5</sub>	A <sub>4</sub>	A <sub>3</sub>	A <sub>2</sub>	A <sub>1</sub>	A <sub>0</sub>		
1	B[7:0]	B <sub>7</sub>	B <sub>6</sub>	B <sub>5</sub>	B <sub>4</sub>	B <sub>3</sub>	B <sub>2</sub>	B <sub>1</sub>	B <sub>0</sub>		
1	C[7:0]	C <sub>7</sub>	C <sub>6</sub>	C <sub>5</sub>	C <sub>4</sub>	C <sub>3</sub>	C <sub>2</sub>	C <sub>1</sub>	C <sub>0</sub>		
1	D[7:0]	D <sub>7</sub>	D <sub>6</sub>	D <sub>5</sub>	D <sub>4</sub>	D <sub>3</sub>	D <sub>2</sub>	D <sub>1</sub>	D <sub>0</sub>		

**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 B[7:0]: Row Address of Start C[7:0]: Column Address of End D[7:0]: Row Address of End
1	A[7:0]	A <sub>7</sub>	A <sub>6</sub>	A <sub>5</sub>	A <sub>4</sub>	A <sub>3</sub>	A <sub>2</sub>	A <sub>1</sub>	A <sub>0</sub>		
1	B[7:0]	B <sub>7</sub>	B <sub>6</sub>	B <sub>5</sub>	B <sub>4</sub>	B <sub>3</sub>	B <sub>2</sub>	B <sub>1</sub>	B <sub>0</sub>		
1	C[7:0]	C <sub>7</sub>	C <sub>6</sub>	C <sub>5</sub>	C <sub>4</sub>	C <sub>3</sub>	C <sub>2</sub>	C <sub>1</sub>	C <sub>0</sub>		
1	D[7:0]	D <sub>7</sub>	D <sub>6</sub>	D <sub>5</sub>	D <sub>4</sub>	D <sub>3</sub>	D <sub>2</sub>	D <sub>1</sub>	D <sub>0</sub>		
0	26	0	0	1	0	0	1	1	0	Fill Enable / Disable	A[0]: 0b = Disable Fill for Draw Rectangle Command [reset] 1b = Enable Fill for Draw Rectangle Command
1	A[4:0]	*	*	*	A <sub>4</sub>	0	0	0	A <sub>0</sub>		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 <sub>7</sub>	A <sub>6</sub>	A <sub>5</sub>	A <sub>4</sub>	A <sub>3</sub>	A <sub>2</sub>	A <sub>1</sub>	A <sub>0</sub>		
1	B[7:0]	B <sub>7</sub>	B <sub>6</sub>	B <sub>5</sub>	B <sub>4</sub>	B <sub>3</sub>	B <sub>2</sub>	B <sub>1</sub>	B <sub>0</sub>		
1	C[7:0]	C <sub>7</sub>	C <sub>6</sub>	C <sub>5</sub>	C <sub>4</sub>	C <sub>3</sub>	C <sub>2</sub>	C <sub>1</sub>	C <sub>0</sub>		
1	D[7:0]	D <sub>7</sub>	D <sub>6</sub>	D <sub>5</sub>	D <sub>4</sub>	D <sub>3</sub>	D <sub>2</sub>	D <sub>1</sub>	D <sub>0</sub>		
1	E[1:0]	*	*	*	*	*	*	E <sub>1</sub>	E <sub>0</sub>		
											B[7:0]: Define start row address  C[7:0]: Set number of rows to be horizontal scrolled B[7:0]+C[7:0] <=132  D[7:0]: Set number of row as vertical scroll offset Range: 0d-131d ( no vertical scroll if equals to 0)  E[1:0]: Set time interval between each scroll step 00b 3 frames 01b 5 frames 10b 50 frames 11b 100 frames  <b>Note:</b> (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 scroll  <b>Note</b> (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	<p>Activate horizontal scrolling.</p> <p>This command activates the scrolling function according to the setting done by command 27h Continuous Horizontal &amp; Vertical Scrolling Setup</p>
0 1 1	A3 A[7:0] B[7:0]	1 A <sub>7</sub> B <sub>7</sub>	0 A <sub>6</sub> B <sub>6</sub>	1 A <sub>5</sub> B <sub>5</sub>	0 A <sub>4</sub> B <sub>4</sub>	0 A <sub>3</sub> B <sub>3</sub>	0 A <sub>2</sub> B <sub>2</sub>	1 A <sub>1</sub> B <sub>1</sub>	1 A <sub>0</sub> B <sub>0</sub>	Set Vertical Scroll Area	<p>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]</p> <p>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]</p> <p><b>Note</b></p> <p><sup>(1)</sup> A[7:0]+B[7:0] &lt;= MUX ratio</p> <p><sup>(2)</sup> B[7:0] &lt;= MUX ratio</p> <p><sup>(3)</sup> Set Display Start Line (A1h) must be set to 0 when using A3h command.</p> <p><sup>(4)</sup> The last row of the scroll area shifts to the first row of the scroll area.</p> <p><sup>(5)</sup> For 132d MUX display        A[7:0] = 0, B[7:0]=132 : whole area scrolls        A[7:0]= 0, B[7:0] &lt; 132 : top area scrolls        A[7:0] + B[7:0] &lt; 132 : central area scrolls        A[7:0] + B[7:0] = 132 : bottom area scrolls</p> <p>Refer to Figure 10-20 for details.</p>

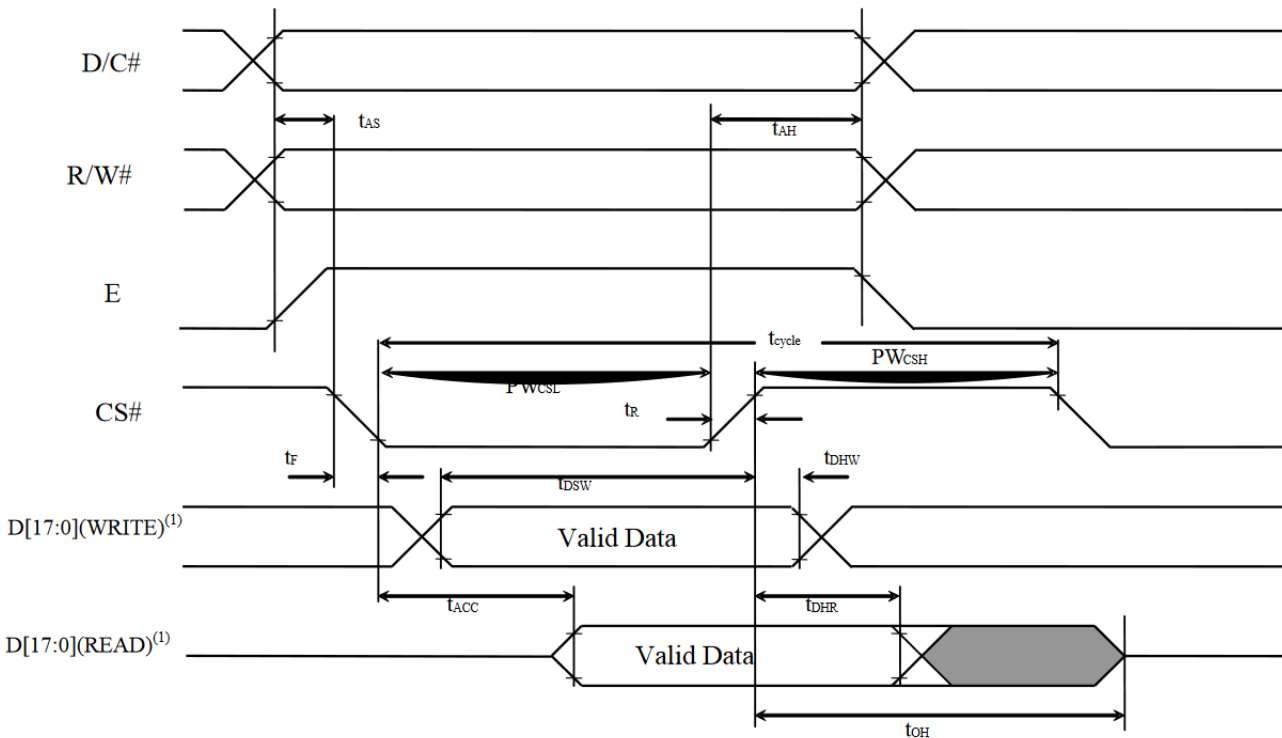


# Timing Characteristics

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



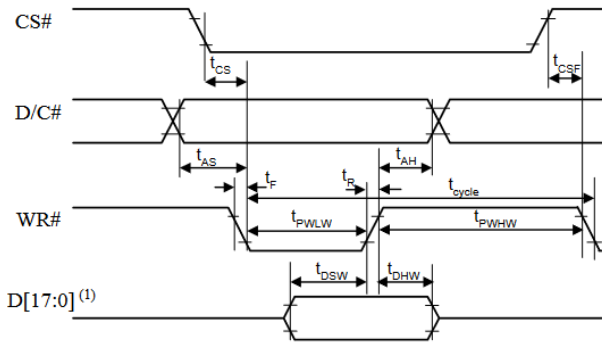
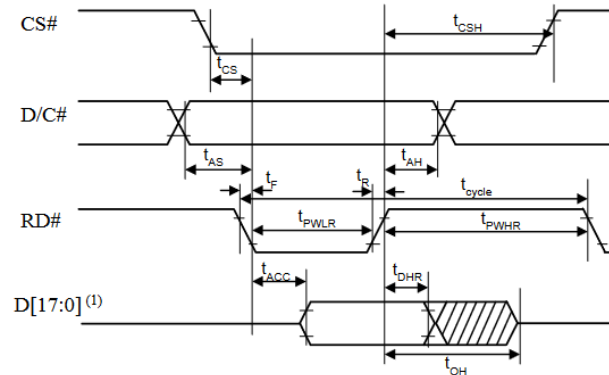
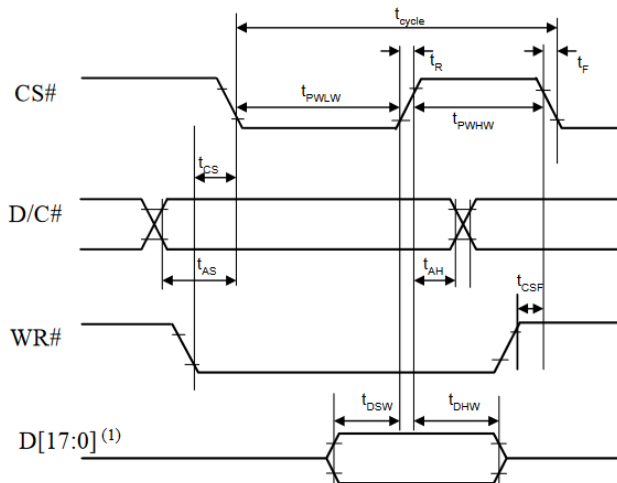
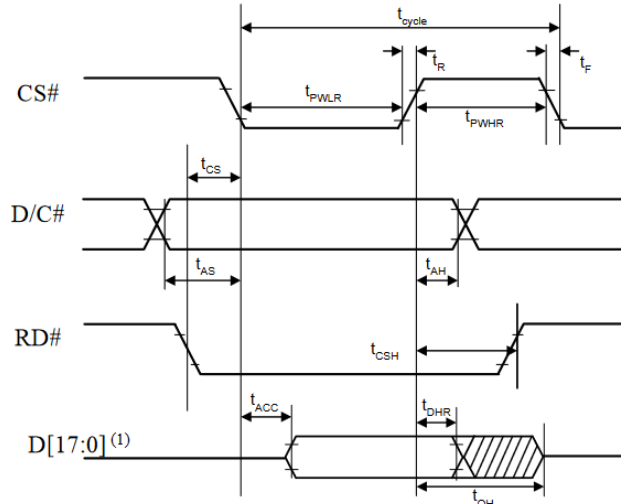
**Note**

<sup>(1)</sup> 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:**
 $(V_{DD} - V_{SS} = 2.4 \text{ to } 2.6\text{V}, V_{DDIO}=1.6\text{V}, V_{CI} = 3.3\text{V}, T_A = 25^\circ\text{C})$ 

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

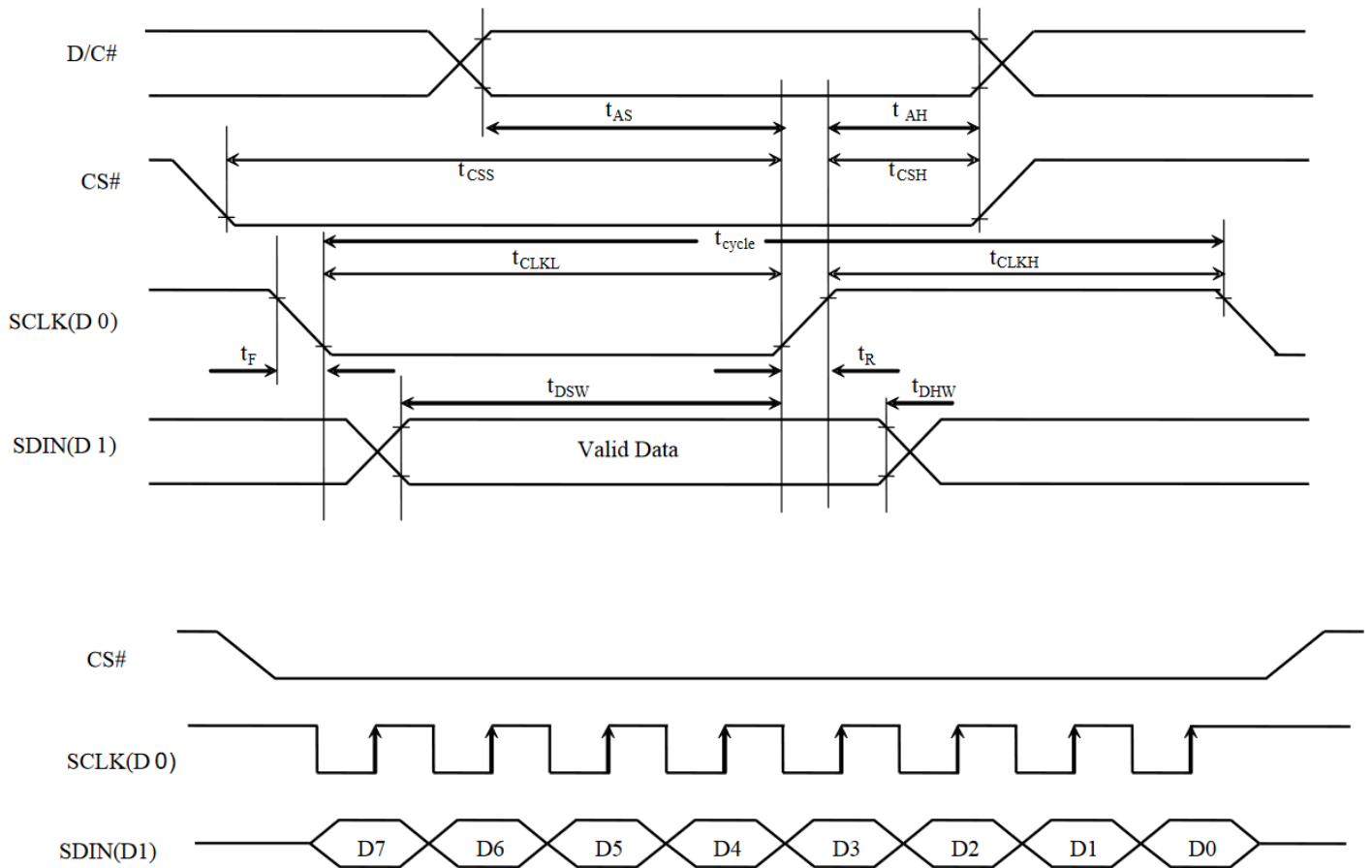
**Write cycle (Form 1)**

**Read cycle (Form 1)**

**Write cycle (Form 2)**

**Read cycle (Form 2)**

**Note**

<sup>(1)</sup> 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:

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

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



## Example Initialization Sequence

## 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, 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.	+70°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.