NEWHAVEN DISPLAY INTERNATIONAL

Product Specification

NHD-1.8-160128B

Graphic Color OLED Display

NHD-	Newhaven Display
1.8-	1.8" Diagonal Size
160128-	160 x 128 Pixels
B-	Model

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REACH Compliant

RoHS Compliant

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Additional Resources

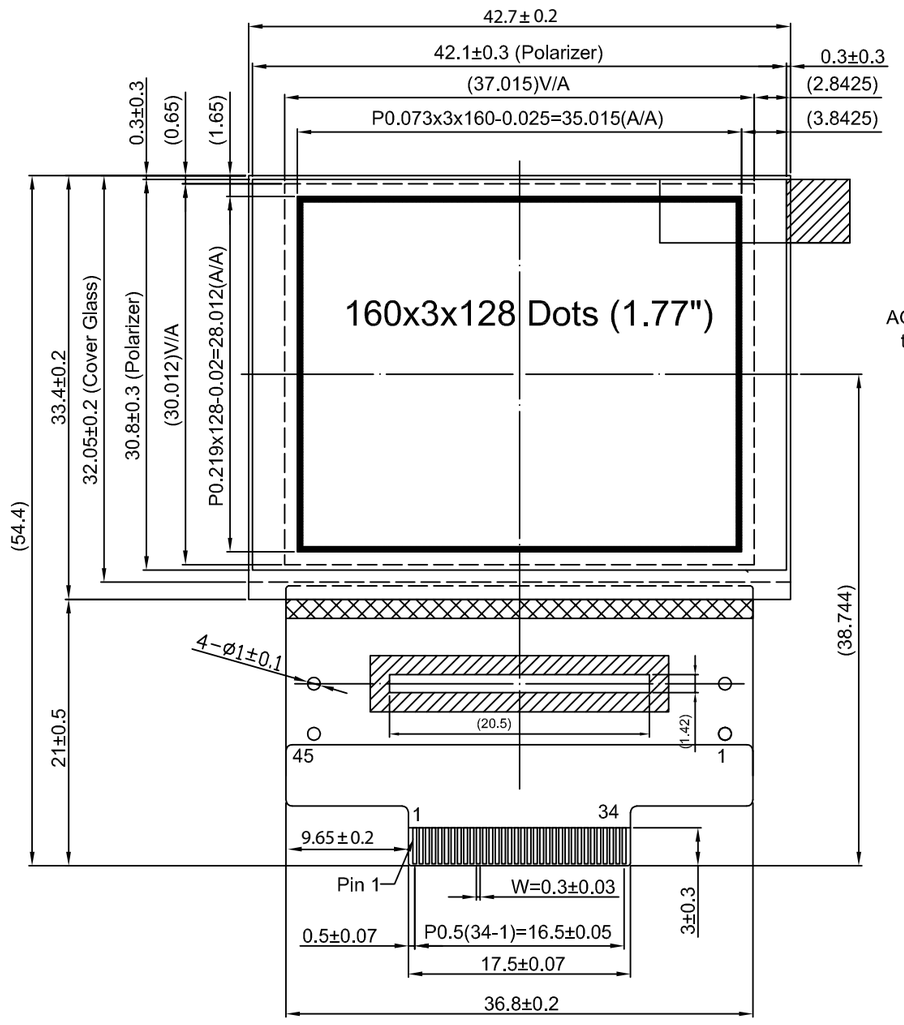
- **Support Forum:** https://support.newhavendisplay.com/hc/en-us/community/topics
- **GitHub:** https://github.com/newhavendisplay
- **Example Code:** https://support.newhavendisplay.com/hc/en-us/categories/4409527834135-Example-Code/
- **Knowledge Center:** https://www.newhavendisplay.com/knowledge_center.html
- **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

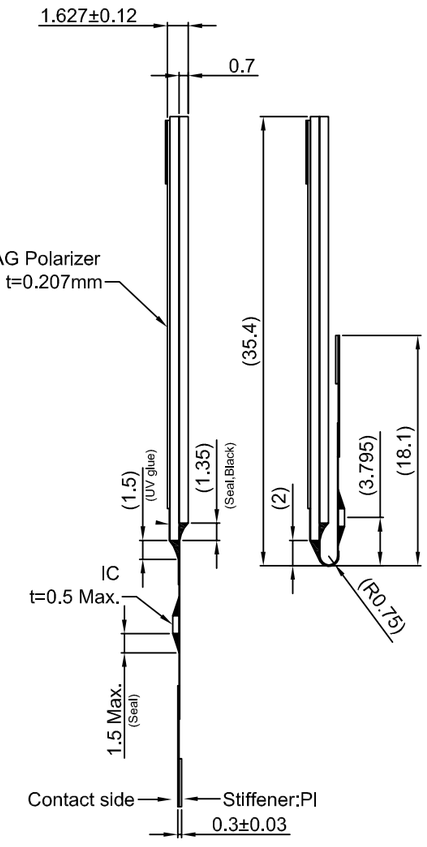
Document Revision History

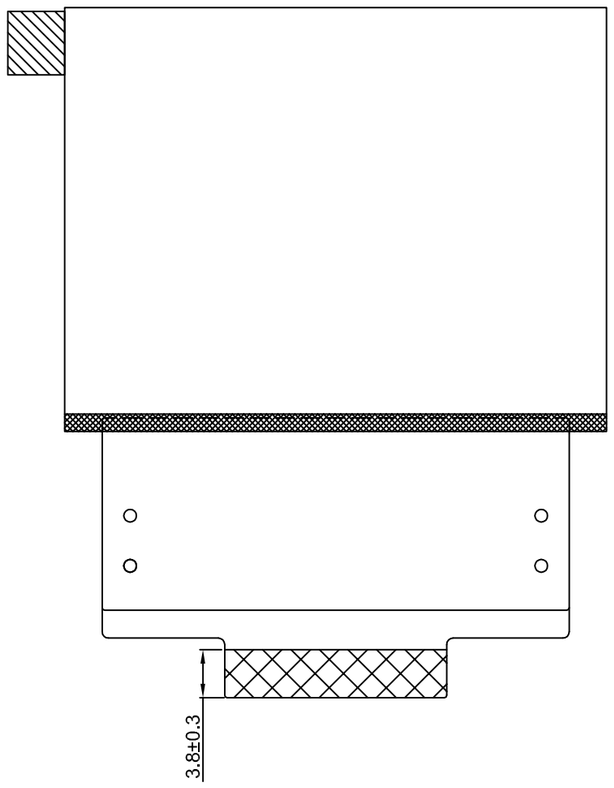
Revision	Date	Description	Changed By
-	04/29/2024	Initial Release	KL
1	07/24/2024	Updated Temperature Range in Electrical Characteristics and Quality Information	KL

Mechanical Drawing

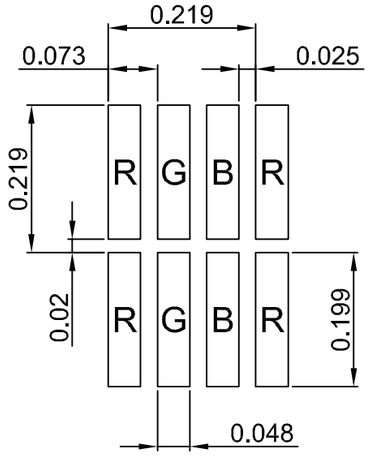
Newhaven Display
NHD-1.8-160128B
Date Code
Part Label (type/format may vary)

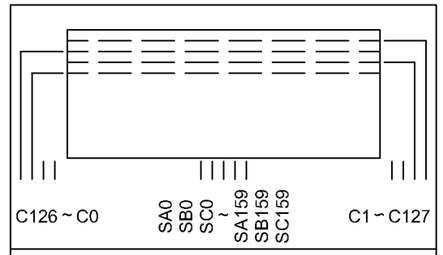






Pin Assignment	
NO.	SYMBOL
1	NC
2	VCC
3	VCOMH
4	VLSS
5	VSS
6	VBREF
7	VSL
8	VCI
9	VPP
10	VDD
11	VDDIO
12	REGVDD
13	BS1
14	BS2
15	FR
16	CS#
17	RES#
18	D/C#
19	R/W#(WR#)
20	E(RD#)
21	D0
22	D1
23	D2
24	D3
25	D4
26	D5
27	D6
28	D7
29	IREF
30	VSS
31	VLSS
32	VCOMH
33	VCC
34	NC





SEG & COM Layout

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

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

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Drawing/Part Number: NHD-1.8-160128B		Revision: 1A
Unless otherwise specified: • Dimensions are in Millimeters • Third Angle Projection	Drawn By: K. Lewis	Approved By: K. Lewis
	Drawn Date: 01/02/2024	Approved Date: 01/02/2024

Pin Description

Pin No.	Symbol	External Connection	Function Description
1	NC	-	No Connect
2	V_{CC}	Power Supply	Supply Voltage for Display (17V)
3	V_{COMH}	Power Supply	Voltage for High Level COM Signal
4	V_{LSS}	Power Supply	Ground
5	V_{SS}	Power Supply	Ground
6	V_{BREF}	Power Supply	Internal Voltage reference signal
7	V_{SL}	Power Supply	Voltage for Low Level SEG signal
8	V_{CI}	Power Supply	Supply Voltage for operation (2.8V)
9	V_{PP}	Power Supply	Connect to V_{DD}
10	V_{DD}	Power Supply	Supply Voltage for Logic
11	V_{DDIO}	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_{DD} regulator is enabled. When this pin is pulled LOW, external V_{DD} 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	**6800 mode**: Read/Write signal. High: Read, LOW: Write **8080 mode**: Active LOW Write signal
20	E (RD#)	MPU	**6800 mode**: Enable signal. Falling edge triggered **8080 mode**: Active LOW Read signal
21-28	D0-D7	MPU	**Parallel Interface:** 8-bit Bi-directional data bus **4-wire SPI Interface:** D0-Serial Clock signal (SCLK) D1-Serial Data Input signal (SDIN) D2-No connect
29	IREF	-	Current for SEG Brightness
30	VSS	Power Supply	Ground
31	VLSS	Power Supply	Ground
32	VCOMH	Power Supply	Voltage for High Level COM signal
33	VCC	Power Supply	Supply Voltage for Display (17V)
34	NC	-	No Connect

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

Interface Selection

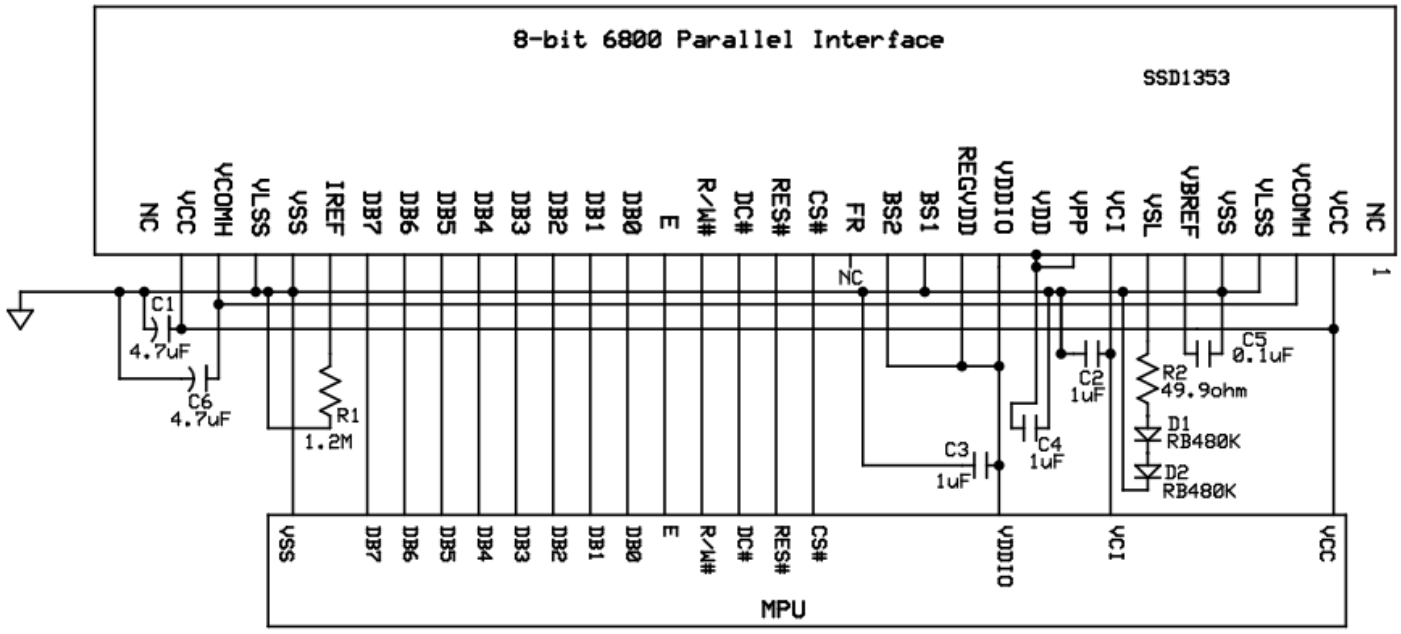
MPU Interface Pin Selections and Assignment Summary

	6800 Parallel	8080 Parallel	4-Wire SPI	I²C
BS1	0	1	0	1
BS2	1	1	0	0

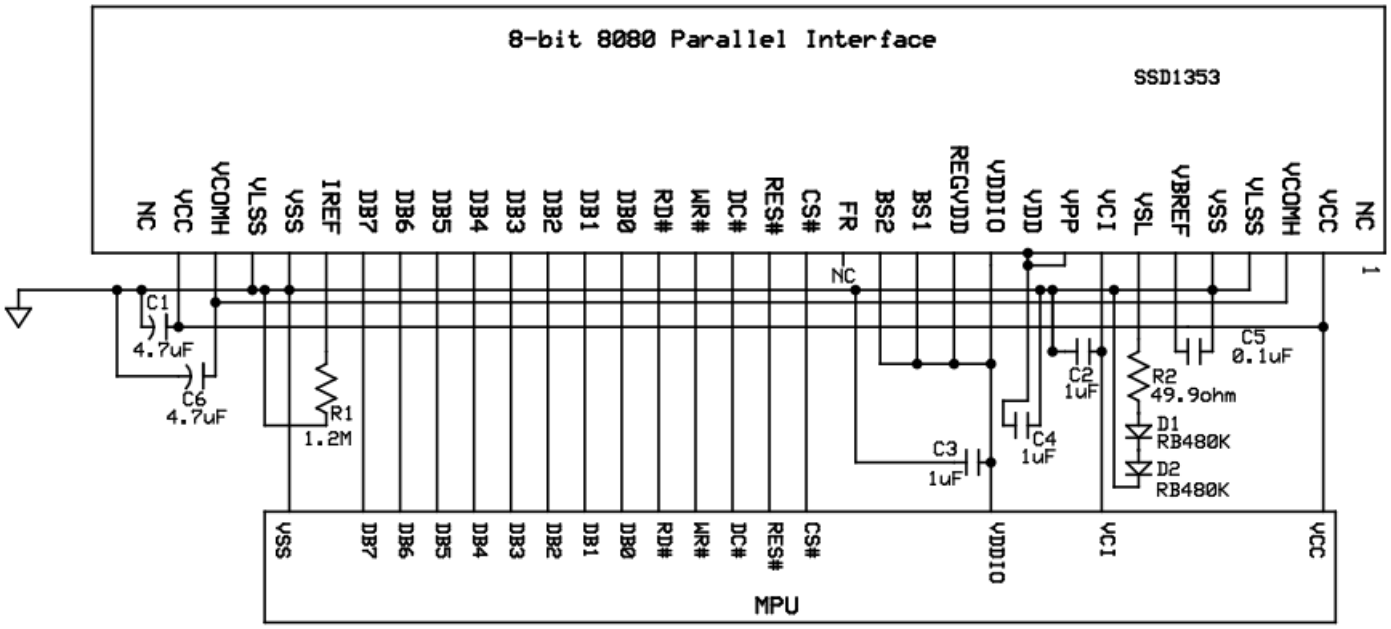
Bus Interface	Data/Command Interface								Control Signals				
	D7	D6	D5	D4	D3	D2	D1	D0	E	R/W#	CS#	D/C#	RES#
8-bit 6800	D[7:0]								E	R/W#	CS#	D/C#	RES#
8-bit 8080	D[7:0]								RD#	WR#	CS#	D/C#	RES#
SPI	Tie Low					NC	SDIN	SCLK	Tie Low		CS#	D/C#	RES#

Wiring Diagram

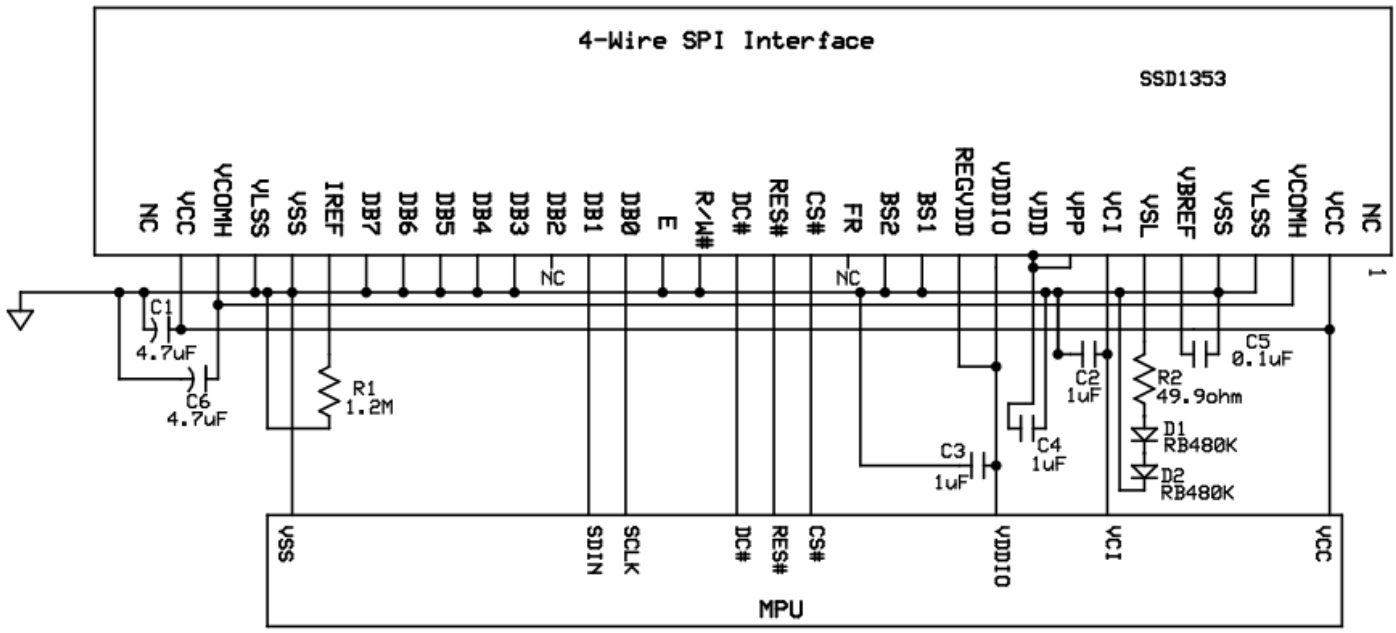
6800 Parallel Interface



8080 Parallel Interface



SPI Interface



Electrical Characteristics

Item	Symbol	Condition	Min.	Typ.	Max.	Unit
Operating Temperature Range	T_{OP}	Absolute Max	-40	-	85	°C
Storage Temperature Range	T_{ST}	Absolute Max	-40	-	90	°C
Supply Voltage for Logic	V_{DD}	-	2.4	2.5	2.6	V
Supply Voltage for I/O pins	V_{DDIO}	-	1.6	1.8	3.5	V
Supply Voltage for Operation	V_{CI}	-	2.4	2.8	3.5	V
Supply Voltage for Display	V_{CC}	-	16.5	17	17.5	V
Supply Current for Display	I_{CC}	V_{CC}=17V, 100% ON	-	39	41	mA
Sleep Mode Current	I_{CC}_sleep	V_{CI} = 2.8V	-	3	5	mA
"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	-	º
	Bottom	φY-		-	80	-	º
	Left	θX-		-	80	-	º
	Right	θX+		-	80	-	º
Contrast Ratio		CR	-	-	>10,000:1	-	-
Response Time	Rise	T_R	-	-	10	-	µs
	Fall	T_F		-	10	-	µs
Brightness		L_V	-	70	100	-	cd/m²
Lifetime		-	70cd/m², 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: 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 in N DCLKs. 2~15 DCLKs allowed. 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	B3	1	0	1	1	0	0	1	1	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]
1	A[7:0]	A_7	A_6	A_5	A_4	A_3	A_2	A_1	A_0		
0	B4	1	0	1	1	0	1	0	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
1	A[3:0]	*	*	*	*	A_3	A_2	A_1	A_0		
0	B8	1	0	1	1	1	0	0	0	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** (1) Input 1d for Gamma Setting 1, 2d for Gamma setting 2, ... ,127d for Gamma Setting127 (2) 0 < Setting of GS1 < Setting of GS2 < Setting of GS3..... Setting 62 < Setting 63 Refer to Section 8.8 for details.
1	A1[3:0]	*	*	*	*	$A1_3$	$A1_2$	$A1_1$	$A1_0$		
1	:	:	:	:	:	:	:	:	:		
1	A7[3:0]	*	*	*	*	$A7_3$	$A7_2$	$A7_1$	$A7_0$		
1	A8[4:0]	*	*	*	$A8_4$	$A8_3$	$A2_2$	$A8_1$	$A8_0$		
1	:	:	:	:	:	:	:	:	:		
1	A15[4:0]	*	*	*	$A15_4$	$A15_3$	$A15_2$	$A15_1$	$A15_0$		
1	A16[5:0]	*	*	$A16_5$	$A16_4$	$A16_3$	$A16_2$	$A16_1$	$A16_0$		
1	:	:	:	:	:	:	:	:	:		
1	A31[5:0]	*	*	$A31_5$	$A31_4$	$A31_3$	$A31_2$	$A31_1$	$A31_0$		
1	A32[6:0]	*	$A32_6$	$A32_5$	$A32_4$	$A32_3$	$A32_2$	$A32_1$	$A31_0$		
1	:	:	:	:	:	:	:	:	:		
1	A63[6:0]	*	$A63_6$	$A63_5$	$A63_4$	$A63_3$	$A63_2$	$A63_1$	$A63_0$		
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] 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] = 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 CCTR3	0 CATR2 CCTR2	0 CATR1 CCTR1	0 CATR0 CCTR0	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 **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
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		
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 **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
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		
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 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_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		
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 A[3:1] : 000 (Reserved values) A[4] : 0b = Disable reverse copy (reset) 1b = Enable reverse during copy command.
1	A[4:0]	*	*	*	A_4	0	0	0	A_0		
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 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 **Note:** (1) Vertical scroll run with command A3h Set Vertical Scroll Area (2) The parameters should not be changed after scrolling is activated
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[1:0]	*	*	*	*	*	*	E_1	E_0		
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.

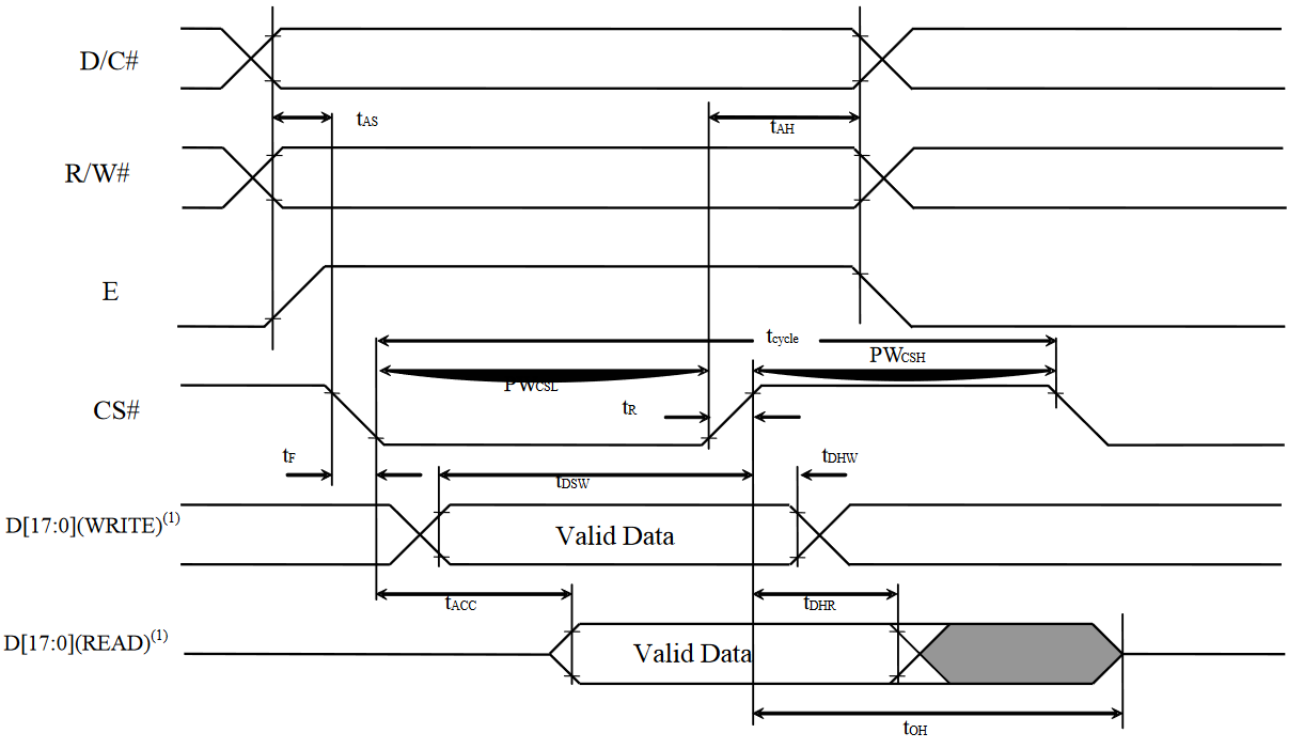
Graphic Acceleration Command Table											
D/C#	**Hex**	**D7**	**D6**	**D5**	**D4**	**D3**	**D2**	**D1**	**D0**	**Command**	**Description**
0	2F	0	0	1	0	1	1	1	1	Activate horizontal scroll	Activate horizontal scrolling. This command activates the scrolling function according to the setting done by command 27h Continuous Horizontal & Vertical Scrolling Setup
0	A3	1	0	1	0	0	0	1	1	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.
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		

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°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



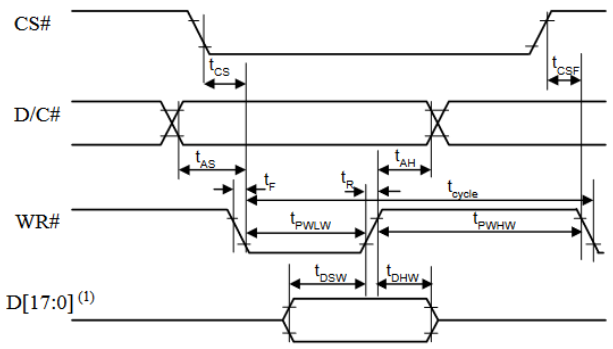
Note
(1) when 8 bit used: D[7:0] instead; when 9 bit used: D[8:0] instead; when 16 bit used: [15:0] instead; when 18 bit used: D[17:0] instead.

8080-Series MCU Parallel Interface:

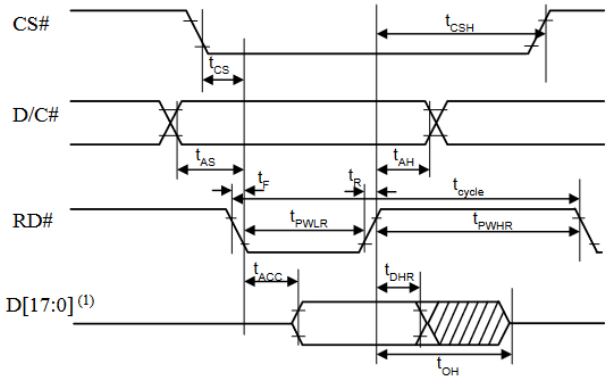
(V_{DD} - V_{SS} = 2.4 to 2.6V, V_{DDIO}=1.6V, V_{CI} = 3.3V, T_A = 25°C)

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

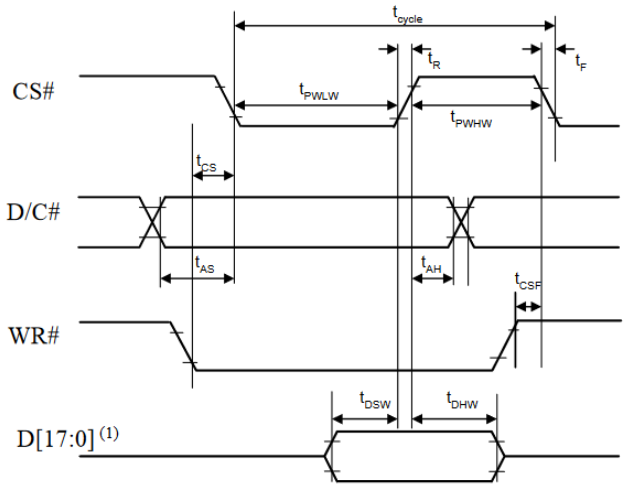
Write cycle (Form 1)



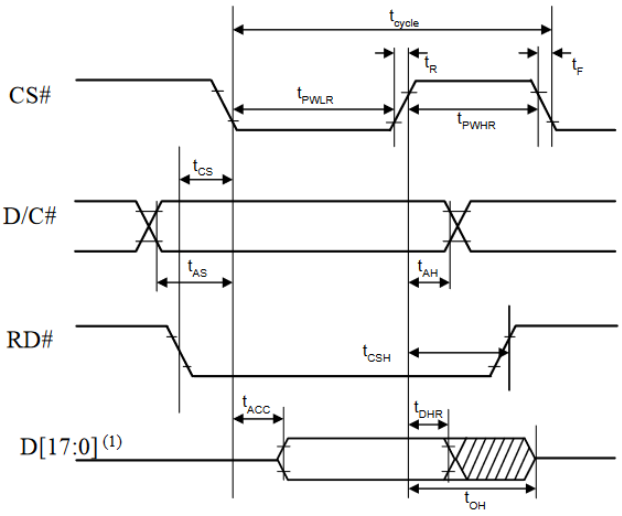
Read cycle (Form 1)



Write cycle (Form 2)



Read cycle (Form 2)



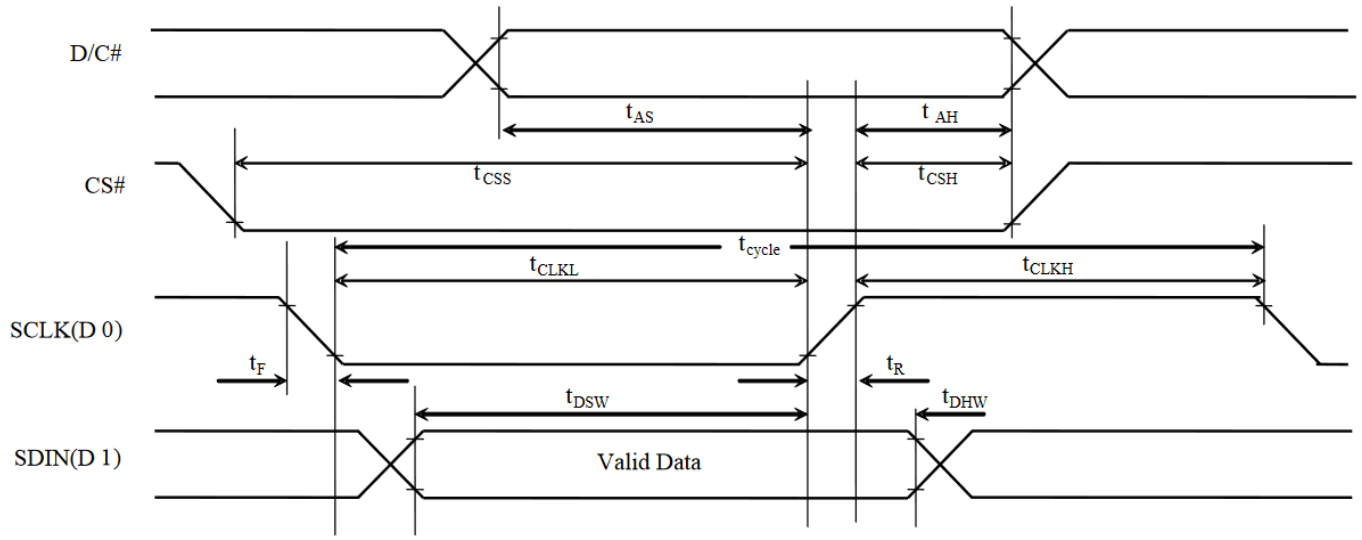
Note

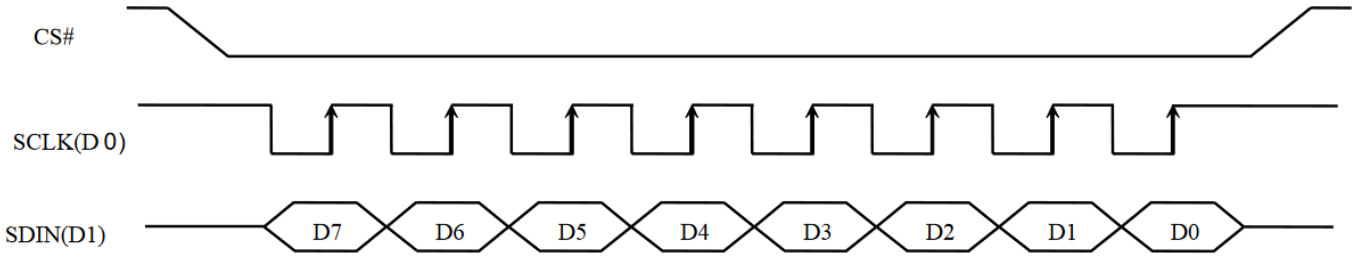
(1) when 8 bit used: D[7:0] instead; when 9 bit used: D[8:0] instead; when 16 bit used: [15:0] instead; when 18 bit used: D[17:0] instead.

4-wire SPI:

(V_{DD} - V_{SS} = 2.4 to 2.6V, V_{DDIO}=1.6V, V_{CI} = 3.3V, T_A = 25°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 mormal 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.