NEWHAVEN DISPLAY INTERNATIONAL

Product Specification

NHD-2.7-12864WDW3-CTP

Graphic OLED Display Module

NHD-	Newhaven Display
2.7-	2.7" Diagonal Size
12864-	128 x 64 Pixel Resolution
WD-	Model
W-	Emitting color: White
3-	+3.3V Power Supply
CTP-	Capacitive Touch Panel

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REACH Compliant

RoHS Compliant

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Additional Resources

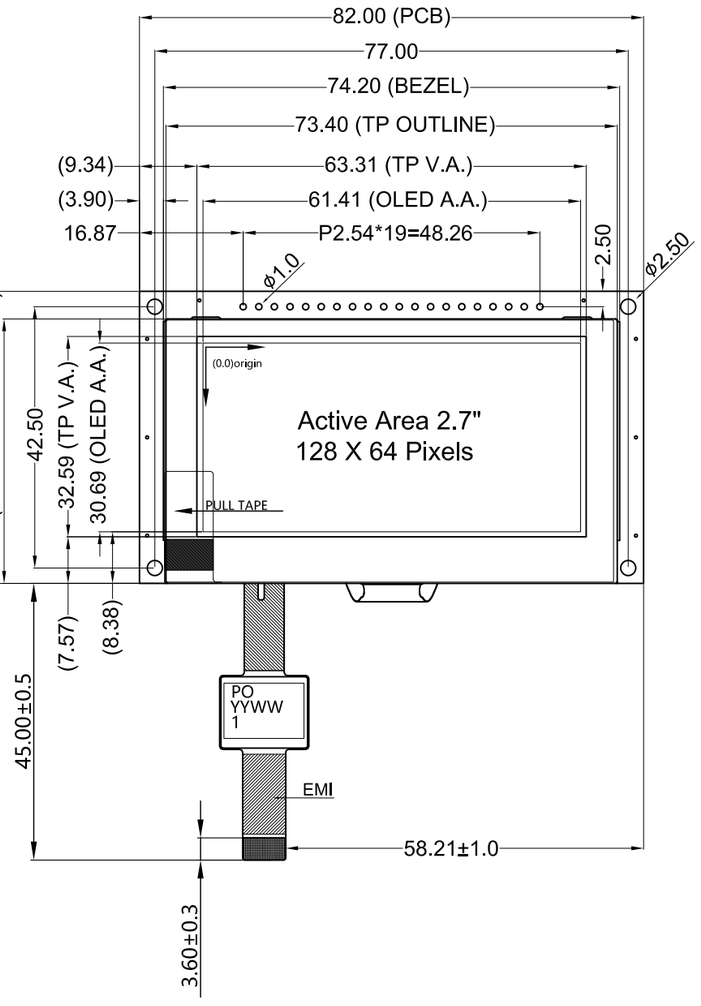
- **Support Forum:** https://support.newhavendisplay.com/hc/en-us/community/topics
- **GitHub:** https://github.com/newhavendisplay
- **Example Code:** https://support.newhavendisplay.com/hc/en-us/categories/4409527834135-Example-Code/
- **Knowledge Center:** https://www.newhavendisplay.com/knowledge_center.html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

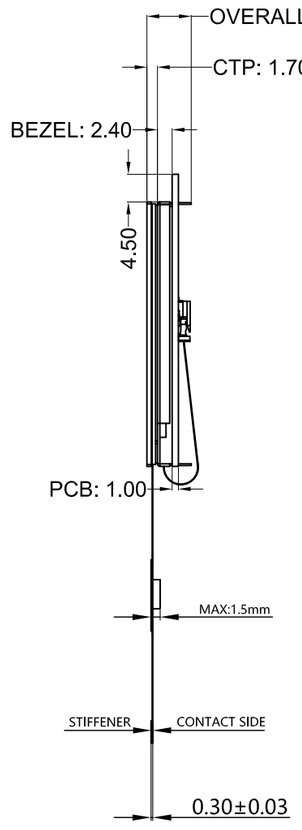
Document Revision History

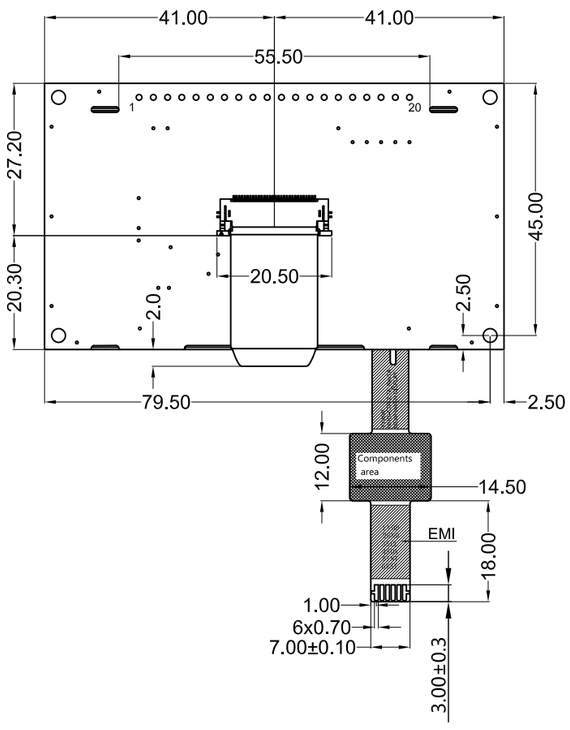
Revision	Date	Description	Changed By
-	03/22/2023	Initial Release	KL

Mechanical Drawing

Newhaven Display
NHD-2.7-12864WDW3-CTP
Date Code
Part Label (type/format may vary)







OLED

Pin No.	Symbol
1	Vss
2	Vdd
3	NC (BC_VDD)
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	N.C. (Vcc)
16	/RES
17	/CS
18	/SHDN (N.C.)
19	BS1
20	BS0

CTP

PIN	DEFINE
1	VDD 3.3V
2	GND
3	SCL 3.3V
4	SDA 3.3V
5	INT 3.3V
6	RESET 3.3V

Product Description: 2.7" 128x64 Graphic OLED w/ Capacitive Touch

1. Driver IC: SSD1322 OLED, FT5426-003 CTP
2. Interface: 8-bit 6800/8080 Parallel, 3/4-wire SPI OLED, I²C CTP
3. Power Requirements: 3.3V OLED, 3.3V CTP
4. Optical Features: White Color, Full View
5. Recommended Connector:
   - OLED: 1x20pin 2.54mm pitch
   - CTP: 6pin 1.0mm pitch; Ex. Molex 52271-0679
6. EMI Shielded FPC

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

NEWHAVEN DISPLAY INTERNATIONAL

Drawing/Part Number: NHD-2.7-12864WDW3-CTP
Revision: -

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

Drawn By: K. Lewis
Approved By: K. Lewis
Drawn Date: 01/05/2023
Approved Date: 01/05/2023

Pin Description

Parallel Interface:

Pin No.	Symbol	External Connection	Function Description
1	V_{SS}	Power Supply	Ground
2	V_{DD}	Power Supply	Supply Voltage for OLED module
3	N.C. (BC_V_{DD})	-	No Connect by default. Can be configured to provide independent supply voltage (2.8V – 12V DC) for boost converter. (refer to On-Board Jumper Options table below)
4	D/C	MPU	Data/Command select signal, D/C=0: Command; D/C=1: Data (tie LOW for 3-wire Serial Interface)
5	R/W or /WR	MPU	**6800-interface:** Read/Write select signal, R/W=1: Read, R/W=0: Write **8080-interface:** Active LOW Write signal
6	E or /RD	MPU	**6800-interface:** Operation Enable signal Active High **8080-interface:** Active LOW Read signal
7-14	DB0 – DB7	MPU	8-bit bi-directional Data Bus
15	N.C. (VCC)	-	No Connect by default. Can be configured for external VCC (+15V). (refer to On-Board Jumper Options section below)
16	/RES	MPU	Active LOW Reset signal
17	/CS	MPU	Active LOW Chip Select signal
18	/SHDN (N.C.)	MPU	Active LOW Shutdown control pin for boost converter (pulled HIGH via on-board 15kΩ resistor) Can be made a No Connect by removing resistor R1.
19	BS1	MPU	MPU Interface select signal
20	BS0	MPU	MPU Interface select signal

Serial Interface:

Pin No.	Symbol	External Connection	Function Description
1	V_{SS}	Power Supply	Ground
2	V_{DD}	Power Supply	Supply Voltage for OLED module
3	N.C. (BC_V_{DD})	-	No Connect by default. Can be configured to provide independent supply voltage (2.8V – 12V DC) for boost converter. (refer to On-Board Jumper Options table below)
4	D/C	MPU	Data/Command select signal, D/C=0: Command; D/C=1: Data (tie LOW for 3-wire Serial Interface)
5-6	VSS	Power Supply	Ground
7	SCLK	MPU	Serial Clock signal
8	SDIN	MPU	Serial Data Input signal
9	N.C.	-	No Connect
10-14	VSS	Power Supply	Ground
15	N.C. (VCC)	-	No Connect by default. Can be configured for external VCC (+15V). (refer to On-Board Jumper Options section below)
16	/RES	MPU	Active LOW Reset signal
17	/CS	MPU	Active LOW Chip Select signal
18	/SHDN (N.C.)	MPU	Active LOW Shutdown control pin for boost converter (pulled HIGH via on-board 15kΩ resistor) Can be made a No Connect by removing resistor R1.
19	BS1	MPU	MPU Interface select signal
20	BS0	MPU	MPU Interface select signal

Capacitve Touch Panel:

Pin No.	Symbol	External Connection	Function Description
1	V_{DD}	Power Supply	Supply voltage for Logic (3.3V)
2	V_{SS}	Power Supply	Ground
3	SCL	MPU	Serial I2C Clock (Requires 4.7KΩ pull-up resistor)
4	SDA	MPU	Serial I2C Data (Requires 4.7kΩ pull-up resistor)
5	/INT	MPU	Interrupt signal from touch panel module to host
6	/RESET	MPU	Active LOW Reset signal

Recommended connector: 6pin, 1.0mm pitch, FFC connector. Molex P/N 52271-0679

Interface Selection

MPU Interface Pin Selections

Pin Name	6800 Parallel 8-bit interface	8080 Parallel 8-bit interface	3-wire Serial Interface	4-wire Serial Interface
BS1	1	1	0	0
BS0	1	0	1	0

MPU Interface Pin Assignment Summary

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
3-wire SPI	Tie LOW					NC	SDIN	SCLK	Tie LOW		/CS	Tie LOW	/RES
4-wire SPI	Tie LOW					NC	SDIN	SCLK	Tie LOW		/CS	D/C	/RES

On-Board Jumper Options

Default Jumper Setting

R4	R5	R7	Description
Close	Open	Open	**(default)** OLED controller and boost converter + OLED panel are powered from VDD (pin #2). This allows the full module to be powered by a single low-voltage supply.

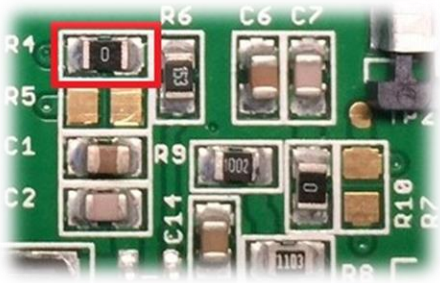
Jumper Option #1 - Independent Supply Voltage for Boost Converter (BC_VDD)

R4	R5	R7	Description
Open	**Close**	Open	Boost converter + OLED panel are powered from BC_VDD (pin #3). OLED controller is still powered from VDD (pin #2). This allows for increased efficiency through the boost converter, by allowing a supply voltage up to +12V at its input, BC_VDD (pin #3).

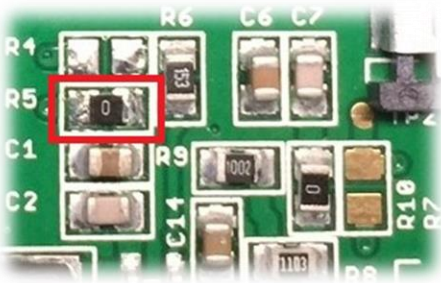
Jumper Option #2 – External Supply Voltage for OLED Panel (VCC)

R4	R5	R7	Description
Open	Open	**Close**	OLED panel is powered from VCC (pin #15) – boost converter is not used. OLED controller is still powered from VDD (pin #2). This allows for maximum module efficiency, and drastically reduced total current consumption.

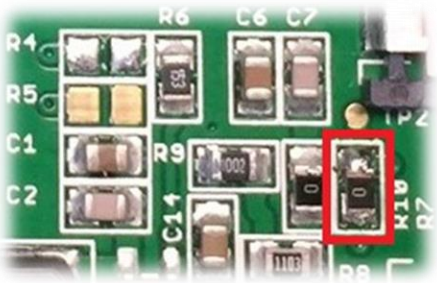
Default Jumper Setting



Jumper Option #1



Jumper Option #2



For detailed electrical information on each jumper option, please see the Electrical Characteristics table below.

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	-	+85	°C
Default Jumper Setting						
Supply Voltage for Module	V_{DD}	-	2.8	3.3	3.5	V
Supply Current for Module	I_{DD}	VDD=3.3V, 50% ON	-	215	235	mA
		VDD=3.3V, 100% ON	-	345	375	mA
Jumper Option #1						
Supply Voltage for Module	V_{DD}	-	2.8	3.3	3.5	V
Supply Voltage for Boost Converter	BC_V_{DD}	-	2.8	-	12	V
Supply Current for Module	I_{DD}	VDD=3.3V	-	190	305	µA
Supply Current for Boost Converter	I_{DD_BC}	BC_VDD=5.0V, 50% ON	-	135	150	mA
		BC_VDD=5.0V, 100% ON	-	200	215	mA
		BC_VDD=12.0V, 50% ON	-	60	70	mA
		BC_VDD=12.0V, 100% ON	-	80	90	mA
Jumper Option #2						
Supply Voltage for Module	V_{DD}	-	2.8	3.3	3.5	V
Supply Voltage for OLED Panel	V_{CC}	-	14.5	15	15.5	V
Supply Current for Module	I_{DD}	V_{DD}=3.3V	-	180	300	µA
Supply Current for OLED Panel	I_{CC}	V_{CC}=15V, 50% ON	-	45	50	mA
		V_{CC}=15V, 100% ON	-	60	70	mA
Sleep Mode Current	I_{DD_SLEEP}	-	-	25	120	µA
"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

Note: The electrical characteristics shown above for Jumper Option #1 and Jumper Option #2 apply only when the on-board jumpers are configured accordingly. By default, only Default Jumper Setting supply voltage and current (in bold) need to be considered. For details, see On-Board Jumper Options section on previous page.

Capacitive Touch Panel:

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	-	+85	°C
Supply Voltage	V_{DD}	-	2.8	-	3.3	V
Supply Current – Operating	I_{DD}	-	-	15	23	mA
"H" Level input	V_{IH}	-	0.7*V_{DD}	-	V_{DD}	V
"L" Level input	V_{IL}	-	V_{SS}	-	0.3*V_{DD}	V
"H" Level output	V_{OH}	-	0.7*V_{DD}	-	V_{DD}	V
"L" Level output	V_{OL}	-	V_{SS}	-	0.3*V_{DD}	V

Optical Characteristics

Item		Symbol	Condition	Min.	Typ.	Max.	Unit
Optimal Viewing Angles	Top	φY+	-	-	85	-	o
	Bottom	φY-		-	85	-	o
	Left	θX-		-	85	-	o
	Right	θX+		-	85	-	o
Contrast Ratio		C_r	-	>10,000:1	-	-	-
Response Time	Rise	T_R	-	-	15	-	ns
	Fall	T_F	-	-	15	-	ns
Brightness		L_V	50% Checkerboard	51	68	110	cd/m^2
Lifetime		-	T_{OP} =25°C, L_V=80cd/m^2	30,000	-	-	hrs
		-	T_{OP} =25°C, L_V=60cd/m^2	50,000	-	-	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**. To extend the life of the display, lower values may be used for the contrast setting registers – see below table of commands for details.

Driver/Controller Information

Built-in SSD1322 Source Driver: https://support.newhavendisplay.com/hc/en-us/articles/4414477846679-SSD1322

Built-in FT5426-003 Controller: https://support.newhavendisplay.com/hc/en-us/articles/4414392845079-FT5x26

Table of Commands

Instruction	Code										Description	RESET value
	D/C	HEX	DB7	DB6	DB5	DB4	DB3	DB2	DB1	DB0		
Enable Grayscale Table	0	**00**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	Enable the Grayscale table settings. (see command 0xB8)	
Set Column Address	0 1 1	**15** **A[6:0]** **B[6:0]**	**0** * *	**0** **A6** **B6**	**0** **A5** **B5**	**1** **A4** **B4**	**0** **A3** **B3**	**1** **A2** **B2**	**0** **A1** **B1**	**1** **A0** **B0**	Set column start and end address A[6:0]: Column start address. Range: 0-119d B[6:0]: Column end address. Range: 0-119d	 0 119d
Write RAM Command	0	**5C**	**0**	**1**	**0**	**1**	**1**	**1**	**0**	**0**	Enable MCU to write Data into RAM	
Read RAM Command	0	**5D**	**0**	**1**	**0**	**1**	**1**	**1**	**0**	**1**	Enable MCU to read Data from RAM	
Set Row Address	0 1 1	**75** **A[6:0]** **B[6:0]**	**0** * *	**1** **A6** **B6**	**1** **A5** **B5**	**1** **A4** **B4**	**0** **A3** **B3**	**1** **A2** **B2**	**0** **A1** **B1**	**1** **A0** **B0**	Set row start and end address A[6:0]: Row start address. Range: 0-127d B[6:0]: Row end address. Range: 0-127d	 0 127d
Set Re-map	0 1 1	**A0** **A[5:0]** **B[4]**	**1** **0** *	**0** **0** *	**1** **A5** **0**	**0** **A4** **B4**	**0** **0** **0**	**0** **A2** **0**	**0** **A1** **0**	**0** **A0** **1**	A[0] = 0; Horizontal Address Increment A[0] = 1; Vertical Address Increment A[1] = 0; Disable Column Address remap A[1] = 1; Enable Column Address remap A[2] = 0; Disable Nibble remap A[2] = 1; Enable Nibble remap A[4] = 0; Scan from COM0 to COM[N-1] A[4] = 1; Scan from COM[N-1] to COM0 A[5] = 0; Disable COM split Odd/Even A[5] = 1; Enable COM split Odd/Even B[4] = 0; Disable Dual COM mode B[4] = 1; Enable Dual COM mode Note: A[5] must be 0 if B[4] is 1.	0 0 0 0 0 0
Set Display Start Line	0 1	**A1** **A[6:0]**	**1** *	**0** **A6**	**1** **A5**	**0** **A4**	**0** **A3**	**0** **A2**	**0** **A1**	**1** **A0**	Set display RAM display start line register from 0-127.	0
Set Display Offset	0 1	**A2** **A[6:0]**	**1** *	**0** **A6**	**1** **A5**	**0** **A4**	**0** **A3**	**0** **A2**	**1** **A1**	**0** **A0**	Set vertical shift by COM from 0~127.	0
Display Mode	0	**A4~A7**	**1**	**0**	**1**	**0**	**0**	**X2**	**X1**	**X0**	0xA4 = Entire display OFF 0xA5 = Entire display ON, all pixels Grayscale level 15 0xA6 = Normal display 0xA7 = Inverse display	0xA6
Enable Partial Display	0 1 1	**A8** **A[6:0]** **B[6:0]**	**1** **0** **0**	**0** **A6** **B6**	**1** **A5** **B5**	**0** **A4** **B4**	**1** **A3** **B3**	**0** **A2** **B2**	**0** **A1** **B1**	**0** **A0** **B0**	Turns ON partial mode. A[6:0] = Address of start row B[6:0] = Address of end row (B[6:0] > A[6:0])	
Exit Partial Display	0	**A9**	**1**	**0**	**1**	**0**	**1**	**0**	**0**	**1**	Exit Partial Display mode	
Function Selection	0 1	**AB** **A[0]**	**1** **0**	**0** **0**	**1** **0**	**0** **0**	**1** **0**	**0** **0**	**1** **0**	**1** **A0**	A[0] = 0; External VDD A[0] = 1; Internal VDD regulator	 1

Set Sleep Mode ON/OFF	0	**AE~AF**	**1**	**0**	**1**	**0**	**1**	**1**	**1**	**X0**	0xAE = Sleep Mode ON (display OFF) 0xAF = Sleep Mode OFF (display ON)	
Set Phase Length	0 1	**B1** **A[7:0]**	**1** **A7**	**0** **A6**	**1** **A5**	**1** **A4**	**0** **A3**	**0** **A2**	**0** **A1**	**1** **A0**	A[3:0] = P1. Phase 1 period of 5-31 DCLK clocks A[7:4] = P2. Phase 2 period of 3-15 DCLK clocks	9 7
Set Display Clock Divide Ratio / Oscillator Frequency	0 1	**B3** **A[7:0]**	**1** **A7**	**0** **A6**	**1** **A5**	**1** **A4**	**0** **A3**	**0** **A2**	**1** **A1**	**1** **A0**	A[3:0] = 0000; divide by 1 A[3:0] = 0001; divide by 2 A[3:0] = 0010; divide by 4 A[3:0] = 0011; divide by 8 A[3:0] = 0100; divide by 16 A[3:0] = 0101; divide by 32 A[3:0] = 0110; divide by 64 A[3:0] = 0111; divide by 128 A[3:0] = 1000; divide by 256 A[3:0] = 1001; divide by 512 A[3:0] = 1010; divide by 1024 A[3:0] >= 1011; invalid A[7:4] = Set the Oscillator Frequency. Frequency increases with the value of A[7:4]. Range 0000b~1111b.	0 1100b
VSL / Display Enhancement	0 1 1	**B4** **A[1:0]** **B[7:3]**	**1** **1** **B7**	**0** **0** **B6**	**1** **1** **B5**	**1** **0** **B4**	**0** **0** **B3**	**1** **0** **1**	**0** **A1** **0**	**0** **A0** **1**	A[1:0] = 00b; Enable external VSL A[1:0] = 10b; Internal VSL B[7:3] = 11111b; Enhanced low GS display quality B[7:3] = 10110b; Normal	 10b 10110b
Set GPIO	0 1	**B5** **A[3:0]**	**1** *****	**0** *****	**1** *****	**1** *****	**0** **A3**	**1** **A2**	**0** **A1**	**1** **A0**	A[1:0] = 00; GPIO0 input disabled A[1:0] = 01; GPIO0 input enabled A[1:0] = 10; GPIO0 output LOW A[1:0] = 11; GPIO0 output HIGH A[3:2] = 00; GPIO1 input disabled A[3:2] = 01; GPIO1 input enabled A[3:2] = 10; GPIO1 output LOW A[3:2] = 11; GPIO1 output HIGH	 10b 10b
Set Second Pre-charge Period	0 1	**B6** **A[3:0]**	**1** *****	**0** *****	**1** *****	**1** *****	**0** **A3**	**1** **A2**	**1** **A1**	**0** **A0**	Sets the second precharge period A[3:0] = DCLKs	1000b
Set Grayscale Table	0 1 1 1 1 1 1 1	**B8** **A1[7:0]** **A2[7:0]** **.** **.** **.** **A14[7:0]** **A15[7:0]**	**1** **$A1_7$** **$A2_7$** **.** **.** **.** **$A14_7$** **$A15_7$**	**0** **$A1_6$** **$A2_6$** **.** **.** **.** **$A14_6$** **$A15_6$**	**1** **$A1_5$** **$A2_5$** **.** **.** **.** **$A14_5$** **$A15_5$**	**1** **$A1_4$** **$A2_4$** **.** **.** **.** **$A14_4$** **$A15_4$**	**1** **$A1_3$** **$A2_3$** **.** **.** **.** **$A14_3$** **$A15_3$**	**0** **$A1_2$** **$A2_2$** **.** **.** **.** **$A14_2$** **$A15_2$**	**0** **$A1_1$** **$A2_1$** **.** **.** **.** **$A14_1$** **$A15_1$**	**0** **$A1_0$** **$A2_0$** **.** **.** **.** **$A14_0$** **$A15_0$**	Sets the gray scale pulse width in units of DCLK. Range 0-180d. A1[7:0] = Gamma Setting for GS1 A2[7:0] = Gamma Setting for GS2 . . . A14[7:0] = Gamma Setting for GS14 A15[7:0] = Gamma Setting for GS15 Note: 0 < GS1 < GS2 < GS3 … < GS14 < GS15 The setting must be followed by command 0x00.	

Select Default Linear Gray Scale Table	0	**B9**	**1**	**0**	**1**	**1**	**1**	**0**	**0**	**1**	Sets Linear Grayscale table GS0 pulse width = 0 GS0 pulse width = 0 GS0 pulse width = 8 GS0 pulse width = 16 . . . GS0 pulse width = 104 GS0 pulse width = 112	
Set Pre-charge Voltage	0 1	**BB** **A[4:0]**	**1** *	**0** *	**1** *	**1** **A4**	**1** **A3**	**0** **A2**	**1** **A1**	**1** **A0**	Set precharge voltage level. A[4:0] = 0x00; 0.20*VCC . . A[4:0] = 0x3E; 0.60*VCC	0x17
Set VCOMH Voltage	0 1	**BE** **A[3:0]**	**1** *	**0** *	**1** *	**1** *	**1** **A3**	**1** **A2**	**1** **A1**	**0** **A0**	Sets the VCOMH voltage level A[3:0] = 0x00; 0.72*VCC . . A[3:0] = 0x04; 0.8*VCC . . A[3:0] = 0x07; 0.86*VCC	0x04
Set Contrast Control	0 1	**C1** **A[7:0]**	**1** **A7**	**1** **A6**	**0** **A5**	**0** **A4**	**0** **A3**	**0** **A2**	**0** **A1**	**1** **A0**	Double byte command to select 1 out of 256 contrast steps. Contrast increases as the value increases.	0x7F
Master Contrast Control	0 1	**C7** **A[3:0]**	**1** *	**1** *	**0** *	**0** *	**0** **A3**	**1** **A2**	**1** **A1**	**1** **A0**	A[3:0] = 0x00; Reduce output for all colors to 1/16 A[3:0] = 0x01; Reduce output for all colors to 2/16 . . A[3:0] = 0x0E; Reduce output for all colors to 15/16 A[3:0] = 0x0F; no change	0x0f
Set Multiplex Ratio	0 1	**CA** **A[6:0]**	**1** *	**1** **A6**	**0** **A5**	**0** **A4**	**1** **A3**	**0** **A2**	**1** **A1**	**0** **A0**	Set MUX ratio to N+1 MUX N=A[6:0]; from 16MUX to 128MUX (0 to 14 are invalid)	127d
Set Command Lock	0 1	**FD** **A[2]**	**1** **0**	**1** **0**	**1** **0**	**1** **1**	**1** **0**	**1** **A2**	**0** **1**	**1** **0**	A[2] = 0; Unlock OLED to enable commands A[2] = 1; Lock OLED from entering commands	0x12

For detailed instruction information, view full SSD1322 datasheet here (pages 32-47):
http://www.newhavendisplay.com/app_notes/SSD1322.pdf

Capacitive Touch Panel Registers

Register No.	Access	Register Name	Bits	Value	Description
01h	RO	Gesture ID	[7:0]	1Ch 14h 10h 18h 49h 48h 00	Swipe Up Swipe Down Swipe Left Swipe Right Zoom Out Zoom In No gesture
02h	RO	Touch Points	[7:0]	0-Ah	0: No touch detected A: 10 touch points detected
03h	RO	TOUCH1_Event_Flag	[7:6]	0 1 2 3	Put Down Put Up Contact Reserved
03h	RO	TOUCH1_XH	[3:0]	0 -1	Upper 4 bits of X touch coordinate
04h	RO	TOUCH1_XL	[7:0]	00 - FFh	Lower 8 bits of X touch coordinate
05h	RO	TOUCH1_YH	[3:0]	0 -1	Upper 4 bits of Y touch coordinate
06h	RO	TOUCH1_YL	[7:0]	00 - FFh	Lower 8 bits of Y touch coordinate
07h	RO	TOUCH1_Weight	[7:0]		Touch Weight
08h	RO	TOUCH1_Misc	[3:0]	00-0Fh	Touch Area
09h	RO	TOUCH2_Event_Flag	[7:6]	0 1 2 3	Put Down Put Up Contact Reserved
09h	RO	TOUCH1_XH	[3:0]	0 -1	Upper 4 bits of X touch coordinate
0Ah	RO	TOUCH2_XL	[7:0]	00 - FFh	Lower 8 bits of X touch coordinate
0Bh	RO	TOUCH2_YH	[3:0]	0 -1	Upper 4 bits of Y touch coordinate
0Ch	RO	TOUCH2_YL	[7:0]	00 - FFh	Lower 8 bits of Y touch coordinate
0Dh	RO	TOUCH2_Weight	[7:0]		Touch Weight
0Eh	RO	TOUCH2_Misc	[3:0]	00-0Fh	Touch Area
0Fh	RO	TOUCH3_Event_Flag	[7:6]	0 1 2 3	Put Down Put Up Contact Reserved
0Fh	RO	TOUCH3_XH	[3:0]	0 -1	Upper 4 bits of X touch coordinate
10	RO	TOUCH3_XL	[7:0]	00 - FFh	Lower 8 bits of X touch coordinate
11h	RO	TOUCH3_YH	[3:0]	0 -1	Upper 4 bits of Y touch coordinate
12h	RO	TOUCH3_YL	[7:0]	00 - FFh	Lower 8 bits of Y touch coordinate
13h	RO	TOUCH3_Weight	[7:0]		Touch Weight
14h	RO	TOUCH3_Misc	[3:0]	00-0Fh	Touch Area
15h	RO	TOUCH4_Event_Flag	[7:6]	0 1 2 3	Put Down Put Up Contact Reserved
15h	RO	TOUCH4_XH	[3:0]	0 -1	Upper 4 bits of X touch coordinate
16h	RO	TOUCH4_XL	[7:0]	00 - FFh	Lower 8 bits of X touch coordinate
17h	RO	TOUCH4_YH	[3:0]	0 -1	Upper 4 bits of Y touch coordinate
18h	RO	TOUCH4_YL	[7:0]	00 - FFh	Lower 8 bits of Y touch coordinate
1Ah	RO	TOUCH4_Misc	[3:0]	00-0Fh	Touch Area
1Bh	RO	TOUCH5_Event_Flag	[7:6]	0 1 2 3	Put Down Put Up Contact Reserved

Register No.	Access	Register Name	Bits	Value	Description
1Bh	RO	TOUCH5_XH	[3:0]	0 -1	Upper 4 bits of X touch coordinate
1Ch	RO	TOUCH5_XL	[7:0]	00 - FFh	Lower 8 bits of X touch coordinate
1Dh	RO	TOUCH5_YH	[3:0]	0 -1	Upper 4 bits of Y touch coordinate
1Eh	RO	TOUCH5_YL	[7:0]	00 - FFh	Lower 8 bits of Y touch coordinate
1Fh	RO	TOUCH5_Weight	[7:0]		Touch Weight
20	RO	TOUCH5_Misc	[3:0]	00-0Fh	Touch Area
21h	RO	TOUCH6_Event_Flag	[7:6]	0 1 2 3	Put Down Put Up Contact Reserved
21h	RO	TOUCH6_XH	[3:0]	0 -1	Upper 4 bits of X touch coordinate
22h	RO	TOUCH6_XL	[7:0]	00 - FFh	Lower 8 bits of X touch coordinate
23h	RO	TOUCH6_YH	[3:0]	0 -1	Upper 4 bits of Y touch coordinate
24h	RO	TOUCH6_YL	[7:0]	00 - FFh	Lower 8 bits of Y touch coordinate
25h	RO	TOUCH6_Weight	[7:0]		Touch Weight
26h	RO	TOUCH6_Misc	[3:0]	00-0Fh	Touch Area
27h	RO	TOUCH7_Event_Flag	[7:6]	0 1 2 3	Put Down Put Up Contact Reserved
27h	RO	TOUCH7_XH	[3:0]	0 -1	Upper 4 bits of X touch coordinate
28h	RO	TOUCH7_XL	[7:0]	00 - FFh	Lower 8 bits of X touch coordinate
29h	RO	TOUCH7_YH	[3:0]	0 – 1	Upper 4 bits of Y touch coordinate
2Ah	RO	TOUCH7_YL	[7:0]	00 - FFh	Lower 8 bits of Y touch coordinate
2Bh	RO	TOUCH7_Weight	[7:0]		Touch Weight
2Ch	RO	TOUCH7_Misc	[3:0]	00-0Fh	Touch Area
2Dh	RO	TOUCH8_Event_Flag	[7:6]	0 1 2 3	Put Down Put Up Contact Reserved
2Dh	RO	TOUCH8_XH	[3:0]	0 – 1	Upper 4 bits of X touch coordinate
2Eh	RO	TOUCH8_XL	[7:0]	00 - FFh	Lower 8 bits of X touch coordinate
2Fh	RO	TOUCH8_YH	[3:0]	0 – 1	Upper 4 bits of Y touch coordinate
30	RO	TOUCH8_YL	[7:0]	00 - FFh	Lower 8 bits of Y touch coordinate
31h	RO	TOUCH8_Weight	[7:0]		Touch Weight
32h	RO	TOUCH8_Misc	[3:0]	00-0Fh	Touch Area
33h	RO	TOUCH9_Event_Flag	[7:6]	0 1 2 3	Put Down Put Up Contact Reserved
33h	RO	TOUCH9_XH	[3:0]	0 - 1	Upper 4 bits of X touch coordinate
34h	RO	TOUCH9_XL	[7:0]	00 - FFh	Lower 8 bits of X touch coordinate
35h	RO	TOUCH9_YH	[3:0]	0 – 1	Upper 4 bits of Y touch coordinate
36h	RO	TOUCH9_YL	[7:0]	00 - FFh	Lower 8 bits of Y touch coordinate
37h	RO	TOUCH9_Weight	[7:0]		Touch Weight
38h	RO	TOUCH9_Misc	[3:0]	00 - 0Fh	Touch Area
39h	RO	TOUCH10_Event_Flag	[7:6]	0 1 2 3	Put Down Put Up Contact Reserved
39h	RO	TOUCH10_XH	[3:0]	0 – 1	Upper 4 bits of X touch coordinate
3Ah	RO	TOUCH10_XL	[7:0]	00 - FFh	Lower 8 bits of X touch coordinate
3Bh	RO	TOUCH10_YH	[3:0]	0 – 1	Upper 4 bits of Y touch coordinate
3Ch	RO	TOUCH10_YL	[7:0]	00 - FFh	Lower 8 bits of Y touch coordinate

Register No.	Access	Register Name	Bits	Value	Description
3Dh	RO	TOUCH10_Weight	[7:0]	00-FFh	Touch Weight
3Eh	RO	TOUCH10_Misc	[3:0]	00-0Fh	Touch Area
A1h	RO	ID_G_LIB_VERSION_H	[7:0]	00-FFh	App library version high-byte Default: 0
A2h	RO	ID_G_LIB_VERSION_L	[7:0]	00-FFh	App library version low-byte Default: 2h
A3h	RO	ID_G_CHIPER_HIGH	[7:0]	00-FFh	Chip Vendor ID Default: 54h
A6h	RO	ID_G_FIRMID	[7:0]	00-FFh	Firmware ID Number Default: 1
A8h	RO	ID_G_VENODRID	[7:0]	00-FFh	CTPM Vendor's Chip ID Default: 79h

MPU Interface

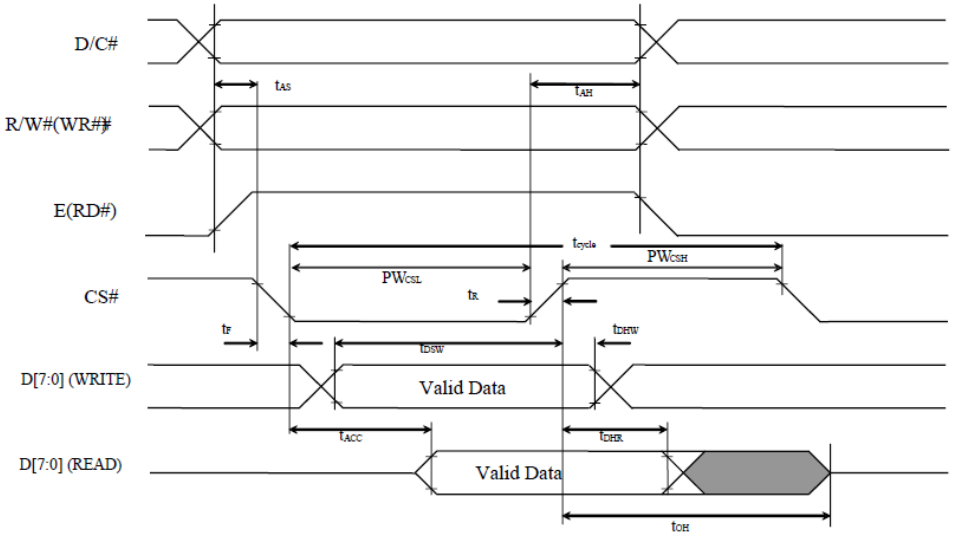
6800-MPU Parallel Interface

The parallel interface consists of 8 bi-directional data pins, R/W, D/C, E, and /CS.
A LOW on R/W indicates write operation, and HIGH on R/W indicates read operation.
A LOW on D/C indicates “Command” read or write, and HIGH on D/C indicates “Data” read or write.
The E input serves as data latch signal, while /CS is LOW. Data is latched at the falling edge of E signal.

Function	E	R/W	/CS	D/C
Write Command	↓	0	0	0
Read Status	↓	1	0	0
Write Data	↓	0	0	1
Read Data	↓	1	0	1

(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
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



8080-MPU Parallel Interface

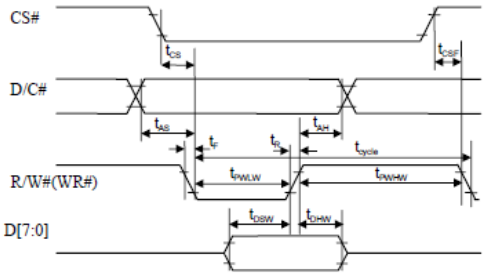
The parallel interface consists of 8 bi-directional data pins, /RD, /WR, D/C, and /CS.
A LOW on D/C indicates “Command” read or write, and HIGH on D/C indicates “Data” read or write.
A rising edge of /RS input serves as a data read latch signal while /CS is LOW.
A rising edge of /WR input serves as a data/command write latch signal while /CS is LOW.

Function	/RD	/WR	/CS	D/C
Write Command	1	↑	0	0
Read Status	↑	1	0	0
Write Data	1	↑	0	1
Read Data	↑	1	0	1

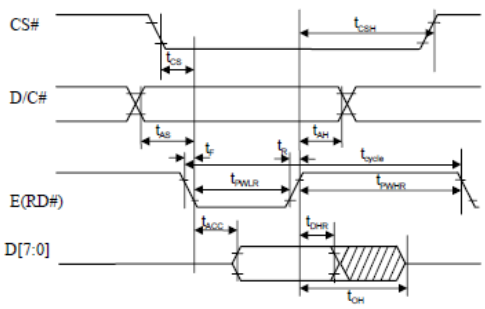
(V_{DD} - V_{SS} = 2.4 to 2.6V, V_{DDIO}=1.6V, V_{CI} = 3.3V, T_A = 25°C)

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



Read cycle



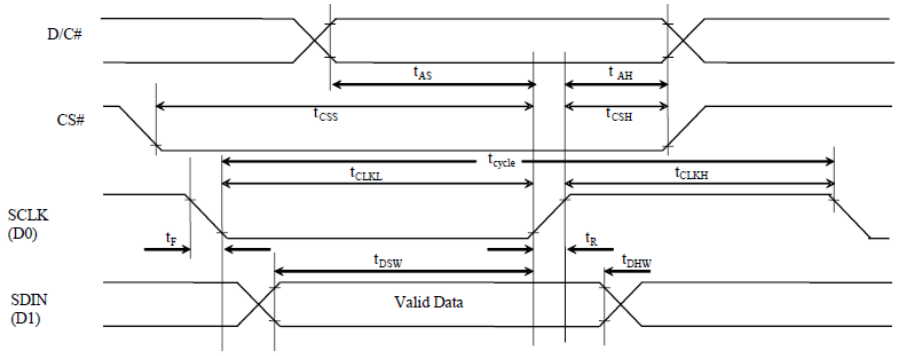
Serial Interface (4-wire)

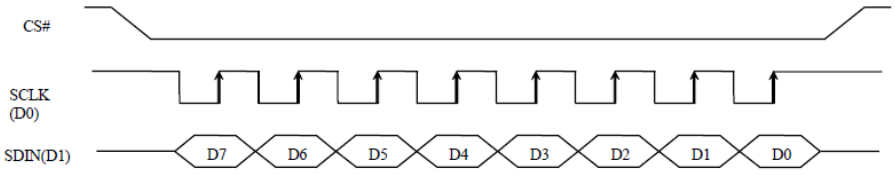
The 4-wire serial interface consists of Serial Clock (SCLK), Serial Data (SDIN), Data/Command (D/C), and Chip Select (/CS). D0 acts as SCLK and D1 acts as SDIN. D2 must be left as a No Connect
D3~D7, E, and R/W should be connected to GND.

Function	/RD	/WR	/CS	D/C	D0
Write Command	Tie LOW	Tie LOW	0	0	↑
Write Data	Tie LOW	Tie LOW	0	1	↑

(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	100	-	-	ns
t_{AS}	Address Setup Time	15	-	-	ns
t_{AH}	Address Hold Time	15	-	-	ns
t_{CSS}	Chip Select Setup Time	20	-	-	ns
t_{CSH}	Chip Select Hold Time	10	-	-	ns
t_{DSW}	Write Data Setup Time	15	-	-	ns
t_{DHW}	Write Data Hold Time	15	-	-	ns
t_{CLKL}	Clock Low Time	20	-	-	ns
t_{CLKH}	Clock High Time	20	-	-	ns
t_R	Rise Time	-	-	15	ns
t_F	Fall Time	-	-	15	ns





SDIN is shifted into an 8-bit shift register on every rising edge of SCLK in the order of D7, D6,…D0.
D/C is sampled on every eighth clock and the data byte in the shift register is written to the GDDRAM or command register in the same clock.
Note: Read functionality is not available in serial mode.

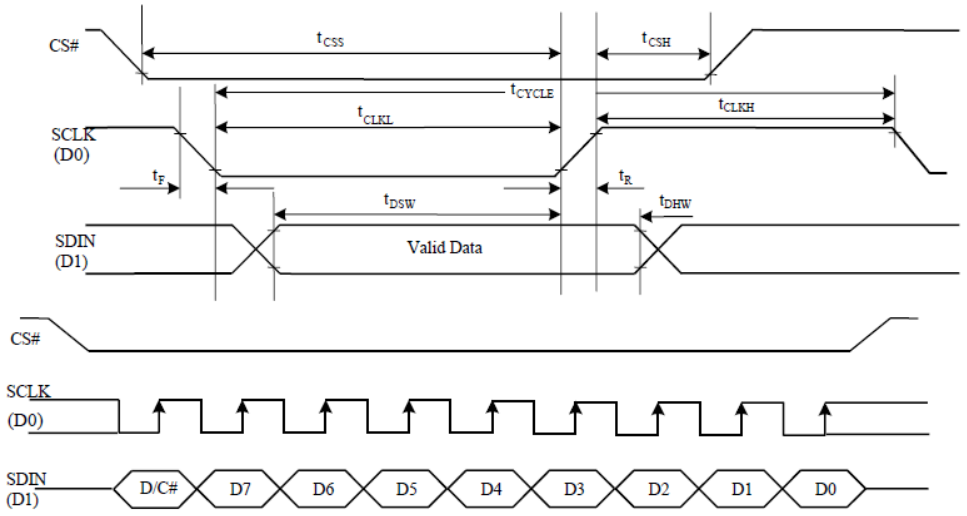
Serial Interface (3-wire)

The 3-wire serial interface consists of Serial Clock (SCLK), Serial Data In (SDIN), and Chip Select (/CS).
D0 acts as SCLK and D1 acts as SDIN. D2 must be left as a No Connect.
D3~D7, E, R/W, and D/C should be connected to Ground.

Function	/RD	/WR	/CS	D/C	D0
Write Command	Tie LOW	Tie LOW	0	Tie LOW	↑
Write Data	Tie LOW	Tie LOW	0	Tie LOW	↑

(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	100	-	-	ns
t_{CSS}	Chip Select Setup Time	20	-	-	ns
t_{CSH}	Chip Select Hold Time	10	-	-	ns
t_{DSW}	Write Data Setup Time	15	-	-	ns
t_{DHW}	Write Data Hold Time	15	-	-	ns
t_{CLKL}	Clock Low Time	20	-	-	ns
t_{CLKH}	Clock High Time	20	-	-	ns
t_R	Rise Time	-	-	15	ns
t_F	Fall Time	-	-	15	ns

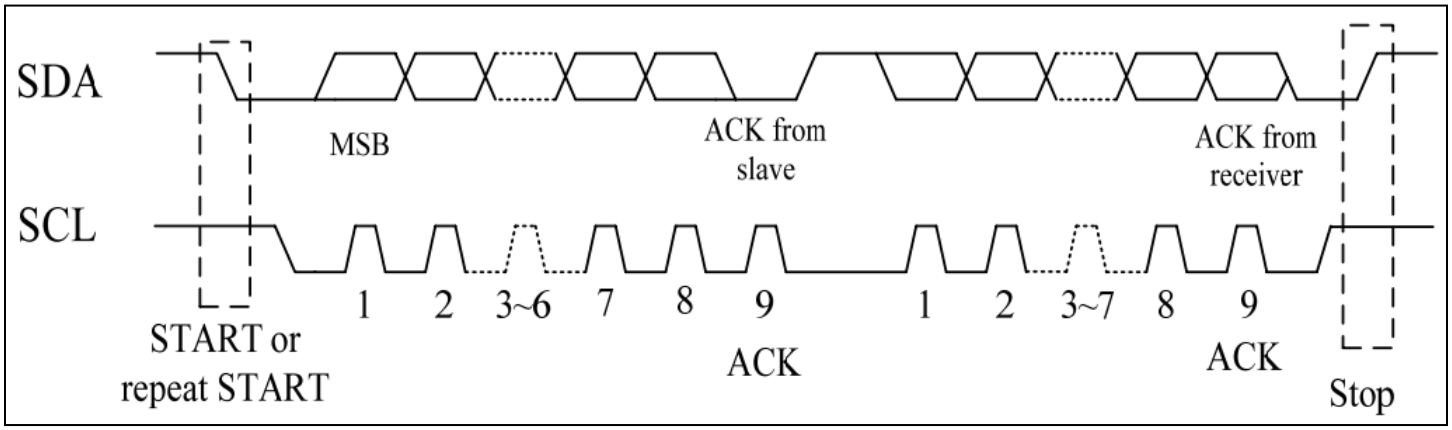


SDIN is shifted into an 9-bit shift register on every rising edge of SCLK in the order of D/C, D7, D6,…D0.
D/C (first bit of the sequential data) will determine if the following data byte is written to the Display Data RAM (D/C = 1) or the command register (D/C = 0).
Note: Read functionality is not available in serial mode.

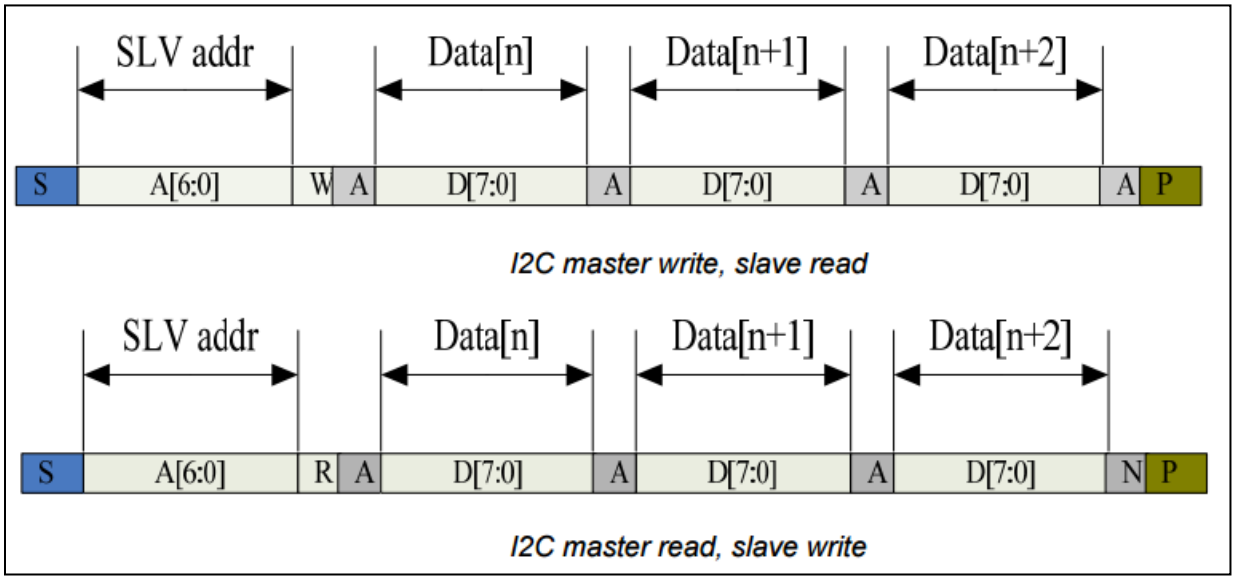
For detailed timing information for each interface mode, view full SSD1322 datasheet here (pages 50-54):
http://www.newhavendisplay.com/app_notes/SSD1322.pdf

Timing Characteristics – Capacitive Touch Panel

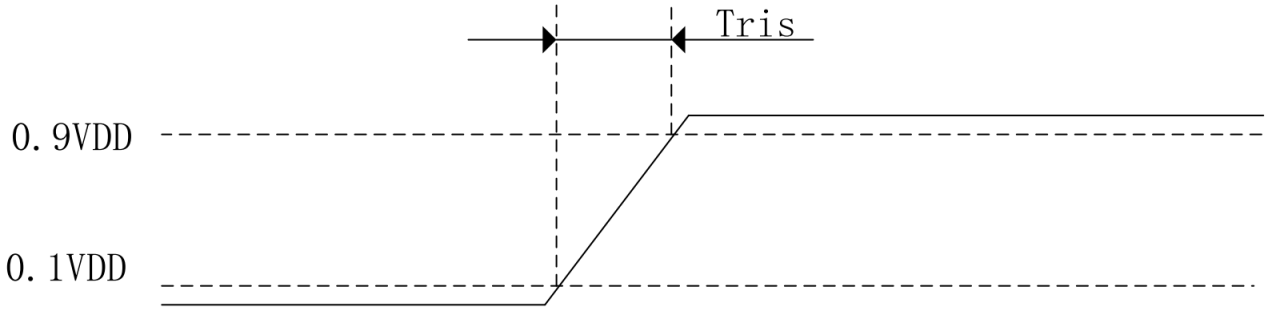
Data Transfer Format



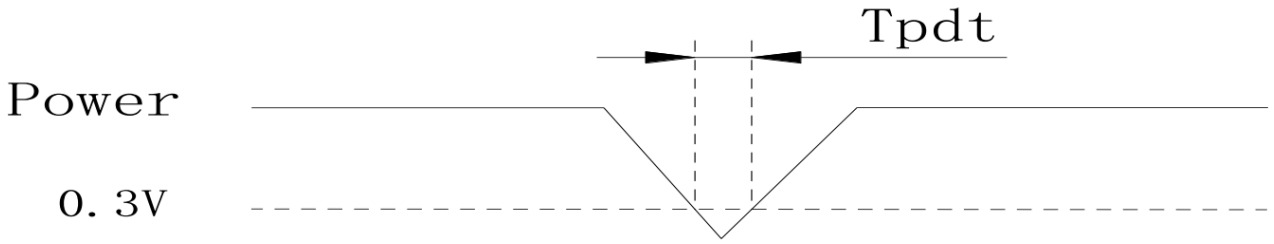
Parameter	Min	Max	Unit
SCL Frequency	0	400	KHz
Bus free time between a STOP & START condition	1.3	-	µs
Hold time Repeated START condition	0.6	-	µs
Data Setup Time	100	-	ns
Setup time for a repeated START condition	0.6	-	µs
Setup time for a STOP condition	0.6	-	µs



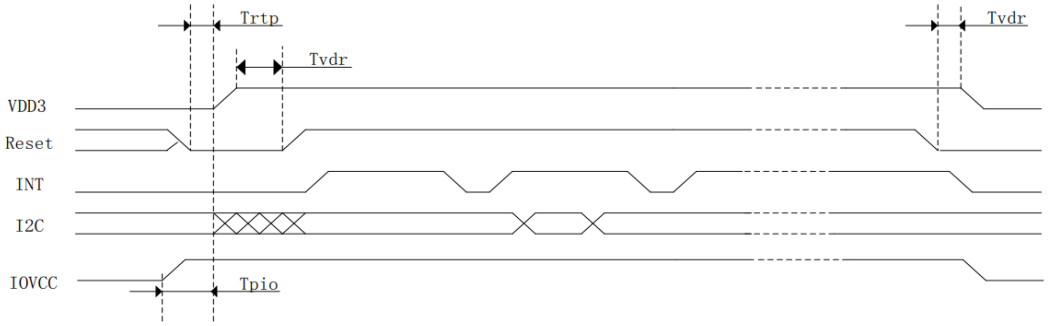
Power ON/Reset Sequence



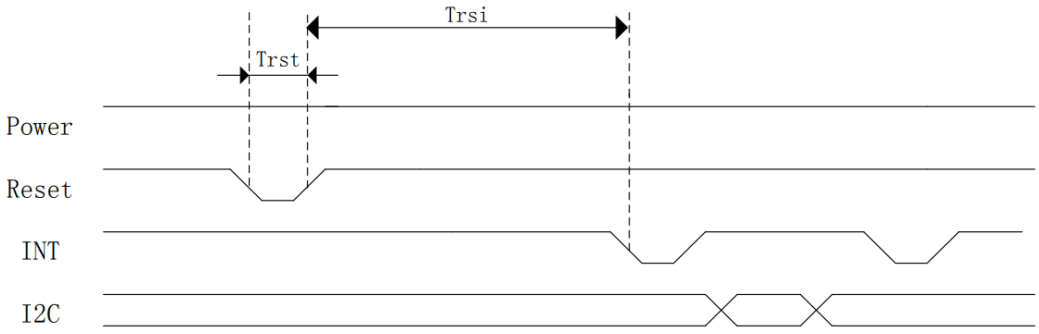
Power On Time



Power Cycle Requirement



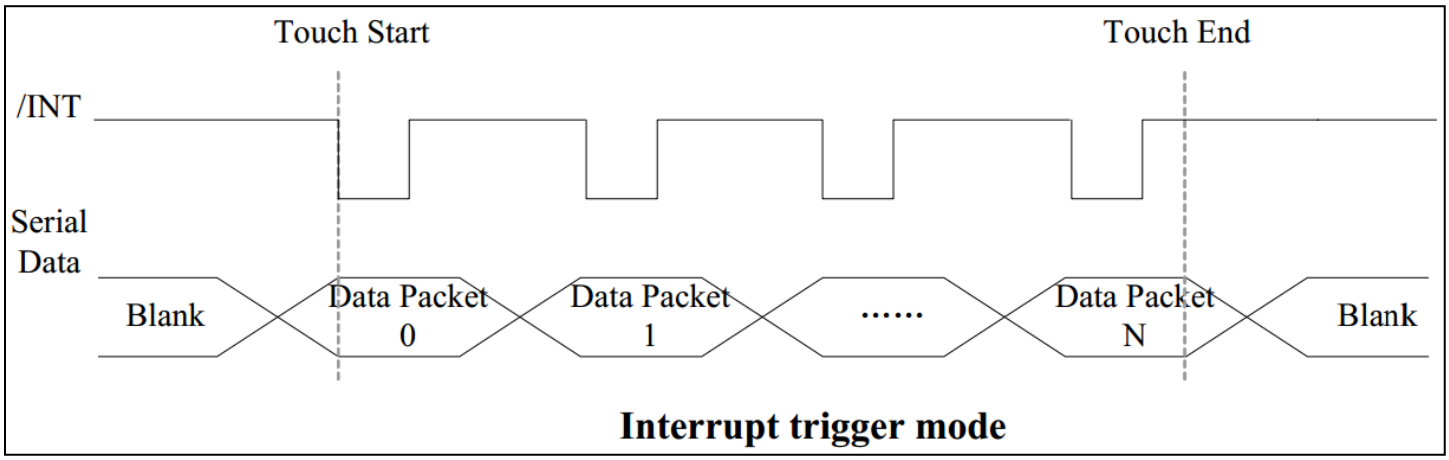
Power ON Sequence



Reset sequence

Parameter	Description	Min	Max	Unit
Tris	Rise time from 0.1V_{DD} to 0.9V_{DD}	-	5	ms
Tpdt	Time of the voltage of supply being below 0.3V	5	-	ms
Trtp	Time of resetting to be low before powering on	100	-	µs
Tpon	Time to start reporting after power on	-	200	ms
Tvdr*	Reset time after applying V_{DD}	1	-	ms
Trsi	Time to start reporting after reset	-	200	ms
Trst*	Reset Time	1	-	ms

*Note: If Reset is tied to V_{DD} data corruption can occur



Interrupt trigger mode

Sample code to read touch data:

```
i2c_start();
i2c_tx(0x70);        //Slave Address (Write)
i2c_tx(0x00);        //Start reading address
i2c_stop();

i2c_start();
i2c_tx(0x71);        //Slave Address (Read)
for(i=0x00;i<0x1F;i++)
{touchdata_buffer[i] = i2c_rx(1);}
i2c_stop();
```

Sample code to overwrite default register values:

```
i2c_start();
i2c_tx(0x70);        //Slave Address (Write)
i2c_tx(0xA4);        //ID_G_Mode
i2c_tx(0x01);        //Disable interrupt status to host
i2c_stop();
```

Recommended Initialization

```
void NHD12864WDY3_Init(void){
        digitalWrite(RES, LOW);          //pull /RES (pin #16) low
        delayUS(200);                    //keep /RES low for minimum 200µs
        digitalWrite(RES, HIGH);         //pull /RES high
        delayUS(200);                    //wait minimum 200µs before sending commands
        writeCommand(0xAE);              //display OFF
        writeCommand(0xB3);              //set CLK div. & OSC freq.
        writeData(0x91);
        writeCommand(0xCA);              //set MUX ratio
        writeData(0x3F);
        writeCommand(0xA2);              //set offset
        writeData(0x00);
        writeCommand(0xAB);              //function selection
        writeData(0x01);
        writeCommand(0xA0);              //set re-map
        writeData(0x16);
        writeData(0x11);
        writeCommand(0xC7);              //master contrast current
        writeData(0x0F);
        writeCommand(0xC1);              //set contrast current
        writeData(0x9F);
        writeCommand(0xB1);              //set phase length
        writeData(0xF2);
        writeCommand(0xBB);              //set pre-charge voltage
        writeData(0x1F);
        writeCommand(0xB4);              //set VSL
        writeData(0xA0);
        writeData(0xFD);
        writeCommand(0xBE);              //set VCOMH
        writeData(0x04);
        writeCommand(0xA6);              //set display mode
        writeCommand(0xAF);              //display ON
}
```

Example Software Routines

```
void setColumn(unsigned char xStart, unsigned char xEnd){
   writeCommand(0x15);       //set column (x-axis) start/end address
   writeData(xStart);        //column start; 28 is left-most column
   writeData(xEnd);          //column end; 91 is right-most column
}

void setRow(unsigned char yStart, unsigned char yEnd){
   writeCommand(0x75);       //set row (y-axis) start/end address
   writeData(yStart);        //row start; 0 is top row
   writeData(yEnd);          //row end; 63 is bottom row
}

void clearDisplay(void){
   unsigned int i;
   setColumn(28,91);         //set column (x-axis) start/end address
   setRow(0,63);             //set row (y-axis) start/end address
   writeRAM();               //single byte command (0x5C) to initiate pixel data write to GDDRAM;
   for(i=0;i<4096;i++){      // ((91-28)+1)*((63-0)+1)
    writeData(0x00);
    writeData(0x00);
   }
}

void write2Pixels(unsigned char xPos, unsigned char yPos, unsigned char pixel1, unsigned char pixel2){
   if(pixel1>=1) pixel1 = 0xFF;          //set 1st pixel value to ON
   else pixel1 = 0x00;                   //set 1st pixel value to OFF
   if(pixel2>=1) pixel2 = 0xFF;          //set 2nd pixel value to ON
   else pixel2 = 0x00;                   //set 2nd pixel value to OFF
   if(xPos>127) xPos = 127;              //boundary check (MIN xPos = 0, MAX xPos = 127)
   xPos = xPos/2;                        //account for GDDRAM address mapping
   xPos+=28;                             //account for GDDRAM address mapping
   if(yPos>63) yPos = 63;                //boundary check (MIN yPos = 0, MAX yPos = 63)
   setColumn(xPos,xPos);                 //set column (x-axis) start/end address
   setRow(yPos,yPos);                    //set row (y-axis) start/end address
   writeRAM();                           //single byte command (0x5C) to initiate pixel data write to GDDRAM;
   writeData(pixel1);                    //write 1st of 2 pixels to the display
   writeData(pixel2);                    //write 2nd of 2 pixels to the display
}

void displayArray12864(const unsigned char arr[]){          //display 128x64 monochrome bitmap, horizontal pixel arrangement, 8-pixels per byte
   unsigned int i, j;
   setColumn(28,91);                     //set column (x-axis) start/end address
   setRow(0,63);                         //set row (y-axis) start/end address
   writeRAM();                           //single byte command (0x5C) to initiate pixel data write to GDDRAM;
   for(i=0;i<1024;i++){                  //translate each byte/bit into pixel data
    for(j=0;j<8;j++){
     if(((arr[i]<<j)&0x80)==0x80){
      writeData(0xFF);
     }
     else{
      writeData(0x00);
     }
    }
   }
}
```

Quality Information

Test Item	Content of Test	Test Condition	Note
High Temperature storage	Endurance test applying the high storage temperature for a long time.	+85°C, 240hrs	2
Low Temperature storage	Endurance test applying the low storage temperature for a long time.	-40°C, 240hrs	1,2
High Temperature Operation	Endurance test applying the electric stress (voltage & current) and the high thermal stress for a long time.	+85°C, 240hrs	2
Low Temperature Operation	Endurance test applying the electric stress (voltage & current) and the low thermal stress for a long time.	-40°C, 240hrs	1,2
High Temperature / Humidity Storage	Endurance test applying the electric stress (voltage & current) and the high thermal with high humidity stress for a long time.	+60°C, 90% RH, 240hrs	1,2
Thermal Shock resistance	Endurance test applying the electric stress (voltage & current) during a cycle of low and high thermal stress.	-40°C, 30min -> +25°C, 5min -> +85°C, 30min = 1 cycle 100 cycles	
Vibration test	Endurance test applying vibration to simulate transportation and use.	10-22Hz, 15mm amplitude. 22-500Hz, 1.5G 30min in each of 3 directions X, Y, Z	3
Atmospheric Pressure Test	Test the endurance of the display by applying atmospheric pressure to simulate transportation by air.	115mbar, 40hrs	3
Static electricity test	Endurance test applying electric static discharge.	Air: ±8KV; 300Ω, 150pF Contact: ±4KV; 300Ω, 150pF	

Note 1: No condensation to be observed.
Note 2: Conducted after 8 hours of chamber ramp down to room temperature, and 4 hours of storage at 25°C.
Note 3: Test performed on product itself, not inside a container.
Evaluation Criteria:
1: Display is fully functional during operational tests and after all tests, at room temperature.
2: No observable defects.
3: Luminance >50% of initial value.
4: Current consumption within 50% of initial value

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