

NHD-1.1-9696G

Graphic Color OLED Display

NHD-	Newhaven Display
1.1-	1.1" Diagonal Size
9696-	96 x 96 Pixels
G-	OLED Glass

Newhaven Display International, Inc.

2661 Galvin Ct.

Elgin IL, 60124

Ph: 847-844-8795

Fax: 847-844-8796

www.newhavendisplay.com

nhtech@newhavendisplay.com

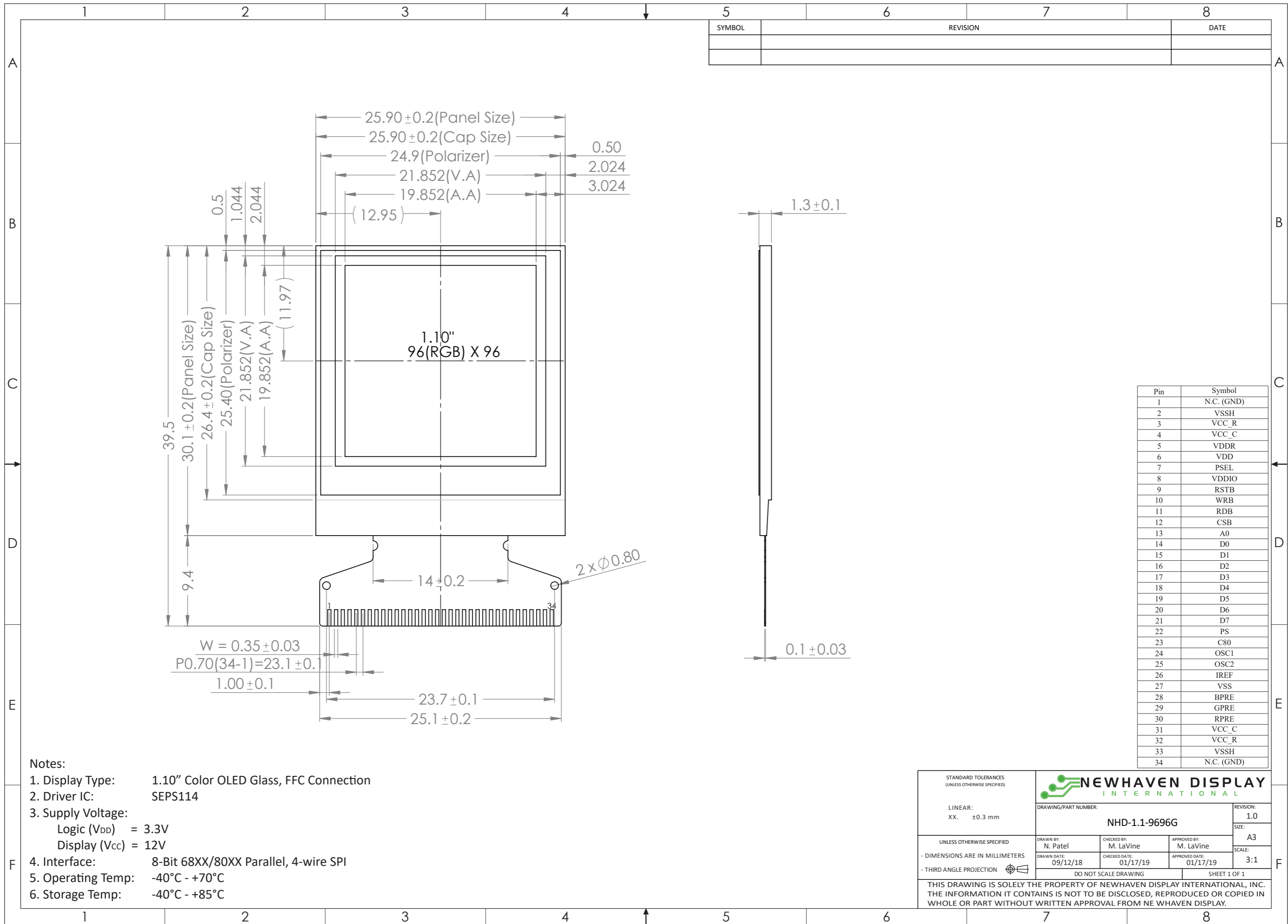
nhsales@newhavendisplay.com

Document Revision History

Revision	Date	Description	Changed by
-	1/25/19	Initial Release	PB

Functions and Features

- 96 x 96 pixel resolution
- Built-in SEPS114 controller
- Serial or Parallel interface
- RoHS compliant



- Notes:
1. Display Type: 1.10" Color OLED Glass, FFC Connection
 2. Driver IC: SEPS114
 3. Supply Voltage:
 - Logic (V_{DD}) = 3.3V
 - Display (V_{CC}) = 12V
 4. Interface: 8-Bit 68XX/80XX Parallel, 4-wire SPI
 5. Operating Temp: -40°C - +70°C
 6. Storage Temp: -40°C - +85°C

STANDARD TOLERANCES (UNLESS OTHERWISE SPECIFIED)

LINEAR: XX. ±0.3 mm

UNLESS OTHERWISE SPECIFIED

- DIMENSIONS ARE IN MILLIMETERS

- THIRD ANGLE PROJECTION

DO NOT SCALE DRAWING

SHEET 1 OF 1

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NEWHAVEN DISPLAY INTERNATIONAL

DRAWING/PART NUMBER: NHD-1.1-9696G

REVISION: 1.0

SIZE: A3

SCALE: 3:1

DRAWN BY: N. Patel	CHECKED BY: M. LaVine	APPROVED BY: M. LaVine
DRAWN DATE: 09/12/18	CHECKED DATE: 01/17/19	APPROVED DATE: 01/17/19

Interface Description

Pin No.	Symbol	External Connection	Function Description
1	NC (GND)	-	No connect (can be tied to Ground)
2	V _{SSH}	Power Supply	Ground for OLED panel
3	V _{CC_R}	Power Supply	Voltage output high level for scan signal (see wiring diagram)
4	V _{CC_C}	Power Supply	Supply voltage for OLED panel
5	V _{DDR}	Power Supply	Power supply for core logic circuit (see wiring diagram)
6	V _{DD}	Power Supply	Supply voltage for Logic
7	PSEL	MPU	Regulator Enable/Disable for core logic (see wiring diagram)
8	V _{DDIO}	Power Supply	Supply voltage for I/O
9	RSTB	MPU	Active LOW Reset signal
10	R/W WRB	MPU	6800 mode: Read/Write signal. LOW: Write. HIGH: Read 8080 mode: Active LOW Write signal
11	E RDB	MPU	6800 mode: Enable signal. Falling edge triggered 8080 mode: Active LOW Read signal
12	CSB	MPU	Active LOW Chip Select signal
13	A0	MPU	Register Select signal. LOW: Command. HIGH: Data
14	D0	MPU	Parallel interface: 8-bit bi-directional data bus Serial interface: D0 = Serial Clock signal (SCL) D1 = Serial Data Input signal (SDI) D2 = Serial Data Output (SDO) D3 = Serial Read High / Write Low (R/W)
15	D1	MPU	
16	D2	MPU	
17	D3	MPU	
18	D4	MPU	
19	D5	MPU	
20	D6	MPU	
21	D7	MPU	
22	PS	MPU	Serial/Parallel Interface selection LOW: Serial. HIGH: Parallel
23	C80	MPU	Parallel mode selection LOW: 8080 mode. HIGH: 6800 mode
24-25	OSC1;OSC2	MPU	Oscillation adjustment. Connect a 27kΩ resistor between these two pins (see wiring diagram)
26	I _{REF}	Power Supply	Current reference for brightness adjustment
27	V _{SS}	Power Supply	Ground
28	B _{PRE}	Power Supply	External voltage reference for Pre-charge signal (see wiring diagram)
29	G _{PRE}	Power Supply	
30	R _{PRE}	Power Supply	
31	V _{CC_C}	Power Supply	Supply voltage for OLED panel
32	V _{CC_R}	Power Supply	Voltage output high level for scan signal (see wiring diagram)
33	V _{SSH}	Power Supply	Ground for OLED panel
34	NC (GND)	-	No connect (can be tied to Ground)

Recommended display connector: n/a (Hot-bar solder directly to PCB)

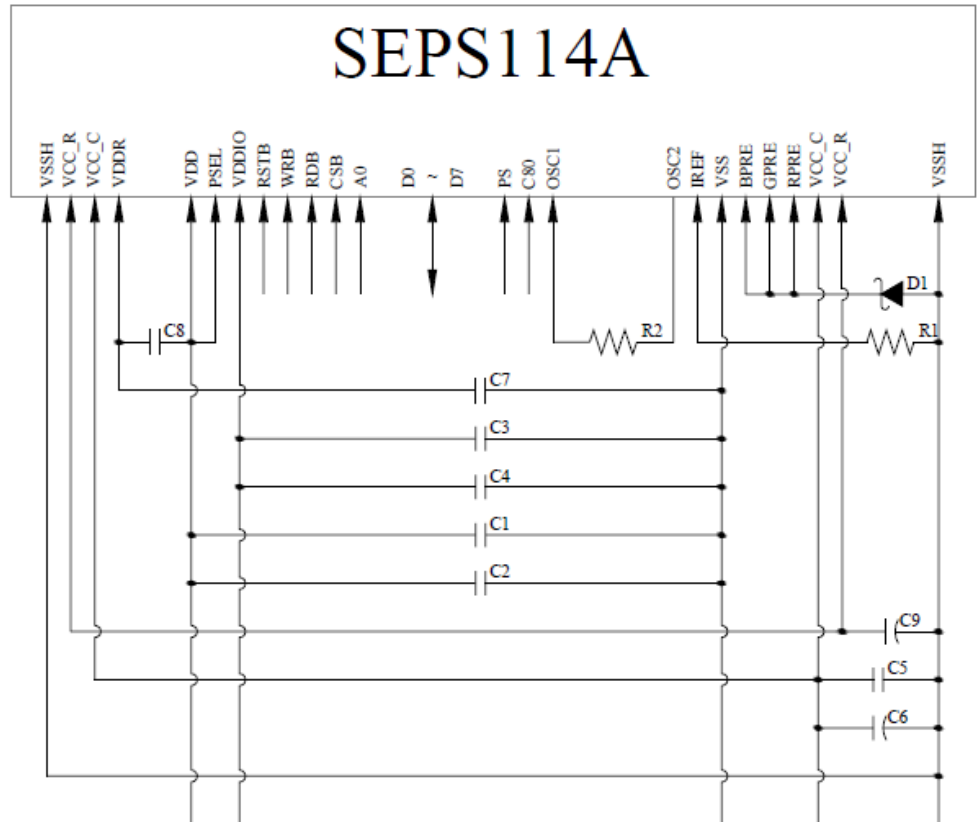
MPU Interface Pin Assignment Summary

Bus Interface	C80	PS	RSTB	CSB	A0	RDB	WRB	D0	D1	D2	D3	D4	D5	D6	D7
8-bit 6800	1	1	RSTB	CSB	A0	E	R/W	D[0:7]							
8-bit 8080	0	1	RSTB	CSB	A0	RDB	WRB	D[0:7]							
4-wire SPI	NC	0	RSTB	CSB	A0	0	0	SCL	SDI	SDO	R/W	0	0	0	0

Note:

- “NC” : No Connect
- “1” : VDD
- “0” : VSS

Wiring Diagram



MCU Interface Selection: PS, C80

Pins connected to MCU interface: RSTB, WRB, RDB, CSB, A0, and D0~D7

C1, C3, C5: 0.1 μ F

C2, C4, C8: 4.7 μ F

C6, C9: 4.7 μ F / 25V Tantalum Capacitor

C7: 2.2 μ F

R1: 39k Ω

R2: 27k Ω

D1: 2.7V, 0.5W Zener Diode

Electrical Characteristics

Item	Symbol	Condition	Min.	Typ.	Max.	Unit
Operating Temperature Range	T _{OP}	Absolute Max	-40	-	+70	°C
Storage Temperature Range	T _{ST}	Absolute Max	-40	-	+85	°C
Supply Voltage for Logic	V _{DD}	-	2.4	2.8	3.3	V
Supply Voltage for I/O Pins	V _{DDIO}	-	1.65	2.8	V _{DD}	
Supply Voltage for Display	V _{CC_C}	-	11.5	12.0	12.5	V
Supply Current for Logic	I _{DD}	V _{DD} = 2.8V; 100% On	-	1.5	3.5	mA
Supply Current for Display	I _{CC_C}	V _{CC_C} = 12V; 50% On	-	10.5	13.1	mA
		V _{CC_C} = 12V; 100% On	-	19.2	24.0	mA
Supply Current (Sleep)	I _{SLEEP}	V _{DD} = 2.8V	-	5	15	μA
"H" Level input	V _{IH}	-	0.8 * V _{DDIO}	-	V _{DDIO}	V
"L" Level input	V _{IL}	-	V _{SS}	-	0.4	V
"H" Level output	V _{OH}	-	V _{DDIO} -0.4	-	V _{DDIO}	V
"L" Level output	V _{OL}	-	V _{SS}	-	0.4	V

Optical Characteristics

Item	Symbol	Condition	Min.	Typ.	Max.	Unit
Optimal Viewing Angles	Top		80	-	-	°
	Bottom		80	-	-	°
	Left		80	-	-	°
	Right		80	-	-	°
Contrast Ratio	CR	-	-	>10,000:1	-	-
Response Time (rise)	T _R	-	-	10	-	μs
Response Time (fall)	T _F	-	-	10	-	μs
Brightness	L _V	50% Checkerboard	80	100	-	cd/m ²
Lifetime	-	100 cd/m ² , T _{OP} =25°C 50% Checkerboard	10,000	-	-	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 SEPS114 controller.

Please download specification at <http://www.newhavendisplay.com/appnotes/datasheets/OLEDs/SEPS114.pdf>

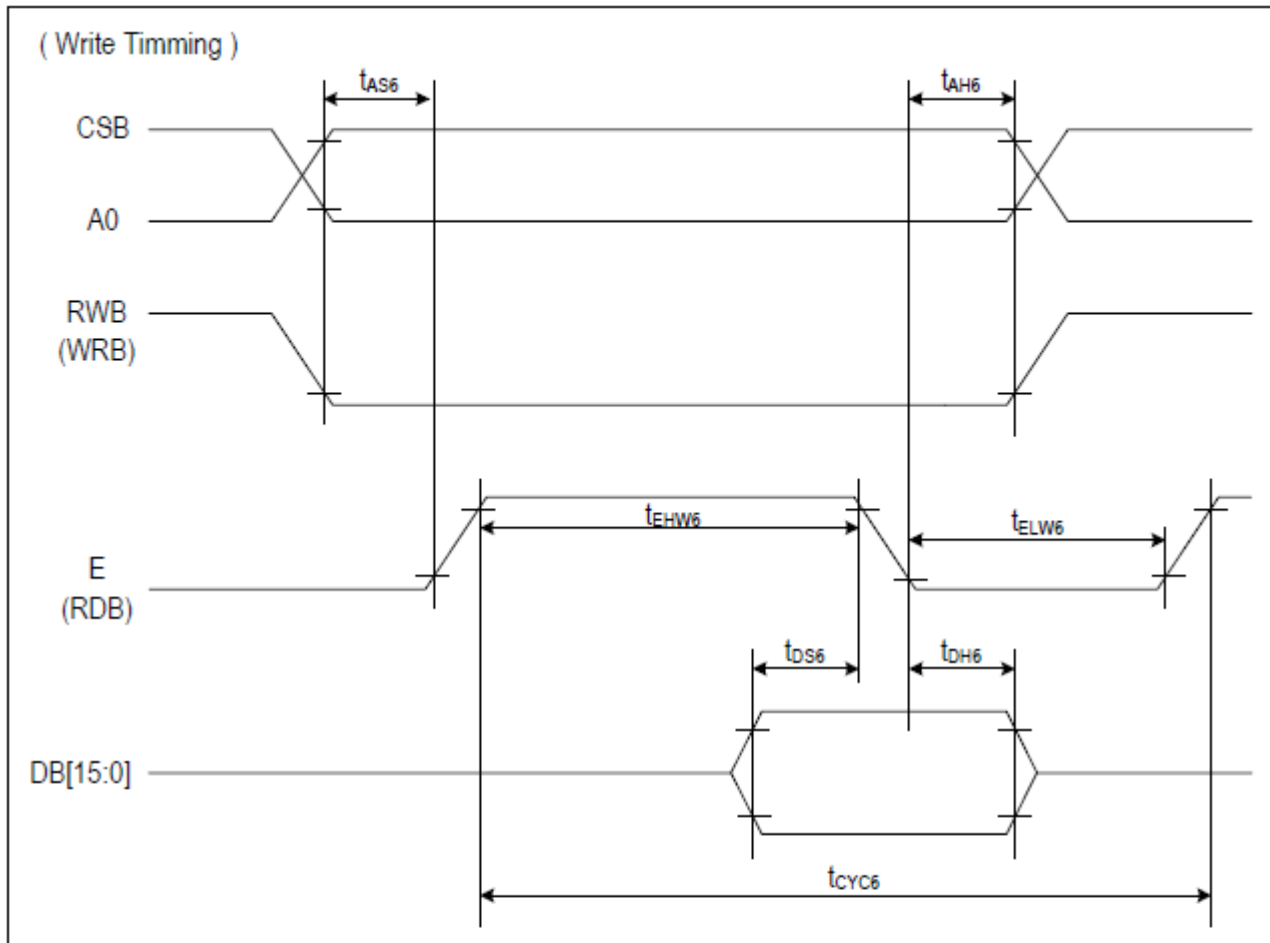
Table of Commands

ADDR	RW	IB7	IB6	IB5	IB4	IB3	IB2	IB1	IB0	Description	Default
01h	W	IDX[7]	IDX[6]	IDX[5]	IDX[4]	IDX[3]	IDX[2]	IDX[1]	IDX[0]	SOFT_RESET	00h
02h	R/W	-	-	-	-	-	-	-	DON	DISP_ON_OFF	00h
0Fh	R/W	SELEXP	SELRES	SELCLK	-	-	-	-	IREF	ANALOG_CONTROL	80h
14h	R/W	-	-	-	-	-	-	-	STB	STANDBY_ON_OFF	01h
1Ah	R/W	-	-	-	-	FR[3]	FR[2]	FR[1]	FR[0]	OSC_ADJUST	03h
09h	R/W	-	-	-	-	-	-	SCAND[1]	SCAND[0]	ROW_SCAN_DIRECTION	00h
30h	R/W	-	FX[6]	FX[5]	FX[4]	FX[3]	FX[2]	FX[1]	FX[0]	DISPLAY_X1	00h
31h	R/W	-	TX[6]	TX[5]	TX[4]	TX[3]	TX[2]	TX[1]	TX[0]	DISPLAY_X2	5Fh
32h	R/W	-	FY[6]	FY[5]	FY[4]	FY[3]	FY[2]	FY[1]	FY[0]	DISPLAY_Y1	00h
33h	R/W	-	TY[6]	TY[5]	TY[4]	TY[3]	TY[2]	TY[1]	TY[0]	DISPLAY_Y2	5Fh
38h	R/W	-	DX[6]	DX[5]	DX[4]	DX[3]	DX[2]	DX[1]	DX[0]	DISPLAYSTART_X	00h
39h	R/W	-	DY[6]	DY[5]	DY[4]	DY[3]	DY[2]	DY[1]	DY[0]	DISPLAYSTART_Y	00h
0Dh	R/W	-	-	-	-	-	-	CIF[1]	CIF[0]	CPU_IF	00h
34h	R/W	-	XS[6]	XS[5]	XS[4]	XS[3]	XS[2]	XS[1]	XS[0]	MEM_X1	00h
35h	R/W	-	XE[6]	XE[5]	XE[4]	XE[3]	XE[2]	XE[1]	XE[0]	MEM_X2	5Fh
36h	R/W	-	YS[6]	YS[5]	YS[4]	YS[3]	YS[2]	YS[1]	YS[0]	MEM_Y1	00h
37h	R/W	-	YE[6]	YE[5]	YE[4]	YE[3]	YE[2]	YE[1]	YE[0]	MEM_Y2	5Fh
1Dh	R/W	-	-	-	-	-	VH	MDIR[1]	MDIR[0]	MEMORY_WRITE/READ	00h
08h	R/W	DDRAM[15:0]								DDRAM_DATA_ACCESS_PORT	00h
18h	R/W	-	-	-	DIS[4]	DIS[3]	DIS[2]	DIS[1]	DIS[0]	DISCHARGE_TIME	08h
16h	R/W	-	-	-	-	PDLY[3]	PDLY[2]	PDLY[1]	PDLY[0]	PEAK_PULSE_DELAY	05h
3Ah	R/W	-	-	-	PWR[4]	PWR[3]	PWR[2]	PWR[1]	PWR[0]	PEAK_PULSE_WIDTH_R	05h
3Bh	R/W	-	-	-	PWG[4]	PWG[3]	PWG[2]	PWG[1]	PWG[0]	PEAK_PULSE_WIDTH_G	05h
3Ch	R/W	-	-	-	PWB[4]	PWB[3]	PWB[2]	PWB[1]	PWB[0]	PEAK_PULSE_WIDTH_B	05h
3Dh	R/W	PCR[7]	PCR[6]	PCR[5]	PCR[4]	PCR[3]	PCR[2]	PCR[1]	PCR[0]	PRECHARGE_CURRENT_R	00h
3Eh	R/W	PCG[7]	PCG[6]	PCG[5]	PCG[4]	PCG[3]	PCG[2]	PCG[1]	PCG[0]	PRECHARGE_CURRENT_G	00h
3Fh	R/W	PCB[7]	PCB[6]	PCB[5]	PCB[4]	PCB[3]	PCB[2]	PCB[1]	PCB[0]	PRECHARGE_CURRENT_B	00h
40h	R/W	DCR[7]	DCR[6]	DCR[5]	DCR[4]	DCR[3]	DCR[2]	DCR[1]	DCR[0]	COLUMN_CURRENT_R	00h
41h	R/W	DCC[7]	DCC[6]	DCC[5]	DCC[4]	DCC[3]	DCC[2]	DCC[1]	DCC[0]	COLUMN_CURRENT_G	00h
42h	R/W	DCB[7]	DCB[6]	DCB[5]	DCB[4]	DCB[3]	DCB[2]	DCB[1]	DCB[0]	COLUMN_CURRENT_B	00h
48h	R/W	-	-	-	-	-	-	ROW[1]	ROW[0]	ROW_OVERLAP	00h
49h	R/W	-	-	-	-	SOFF[3]	SOFF[2]	SOFF[1]	SOFF[0]	SCAN_OFF_LEVEL	04h
17h	R/W	-	-	-	-	-	-	-	SC_ON	ROW_SCAN_ON/OFF	00h
13h	R/W	-	-	-	-	-	-	-	SCM[0]	ROW_SCAN_MODE	00h
D0h	R/W	SMON	-	-	SLON	-	-	-	-	SCREEN_SAVER_CONTROL	00h
D1h	R/W	STIM[7]	STIM[6]	STIM[5]	STIM[4]	STIM[3]	STIM[2]	STIM[1]	STIM[0]	SS_SLEEP_TIMER	00h
D2h	R/W	-	-	-	-	-	SM[2]	SM[1]	SM[0]	SCREEN_SAVER_MODE	00h
D3h	R/W	SSUT[7]	SSUT[6]	SSUT[5]	SSUT[4]	SSUT[3]	SSUT[2]	SSUT[1]	SSUT[0]	SS_UPDATE_TIMER	00h
E0h	R/W	-	-	RIM[1]	RIM[0]	-	-	-	EIM	RGB_IF	00h
E1h	R/W	VSOEN	VSOP	-	-	VSP	HSP	ENP	DOTP	RGB_POL	00h
E5h	R/W	SWAP	-	RC[1]	RC[0]	-	-	DC[1]	DC[0]	DISPLAY_MODE_CONTROL	00h

For the full command table descriptions, please download the following:
<http://www.newhavendisplay.com/appnotes/datasheets/OLEDs/SEPS114.pdf>

Timing Characteristics

Parallel (6800 mode):

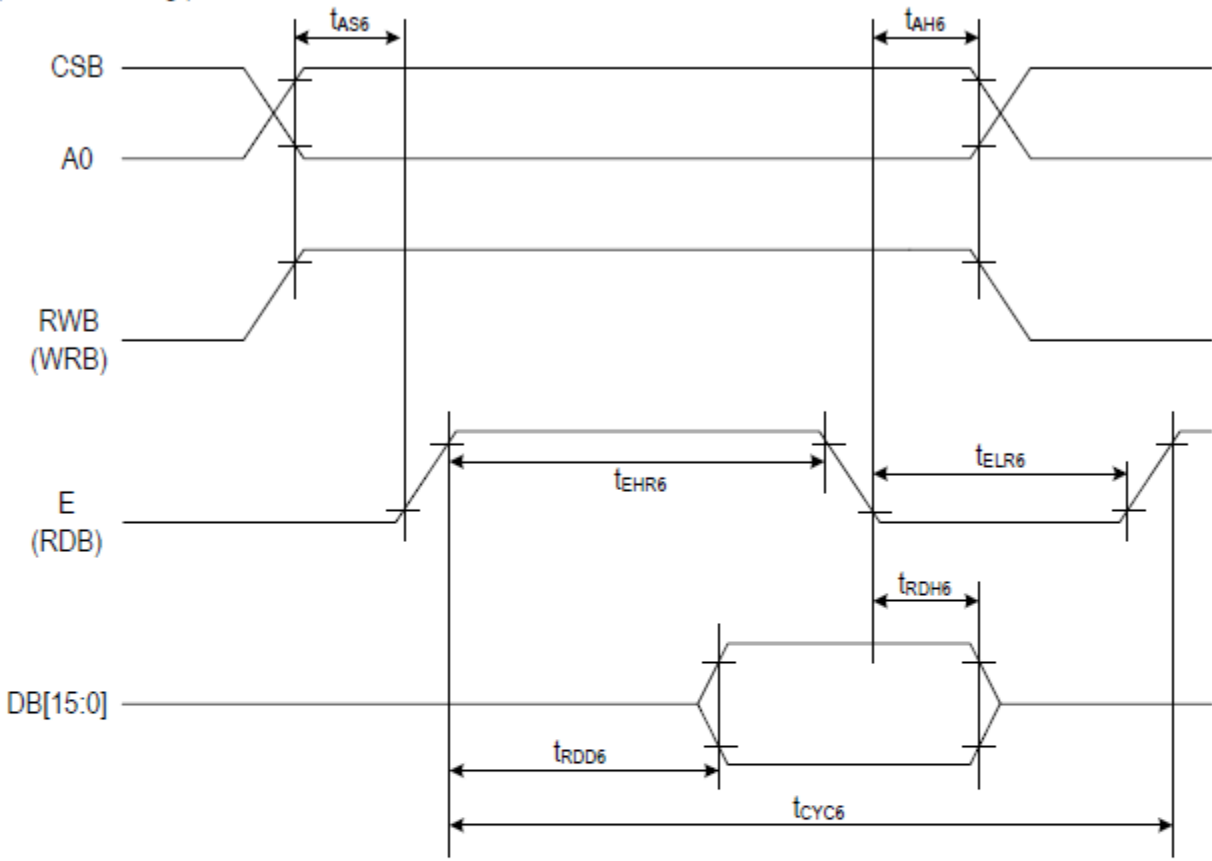


(VDD = 2.8V, Ta = 25°C)

ITEM	SYMBOL	CONDITION	MIN	MAX	UNIT	PORT
Address hold timing	tAH6	-	5	-	ns	CSB
Address setup timing	tAS6	-	5	-	ns	A0
System cycle timing	tCYC6	-	100	-	ns	E
Write "L" pulse width	tELW6	-	45	-	ns	E
Write "H" pulse width	tEHW6	-	45	-	ns	E
Data setup timing	tDS6	-	40	-	ns	DB[15:0]
Data hold timing	tDH6	-	10	-	ns	DB[15:0]

Notice) All the timing reference is 10% and 90% of VDDIO.

(Read Timing)

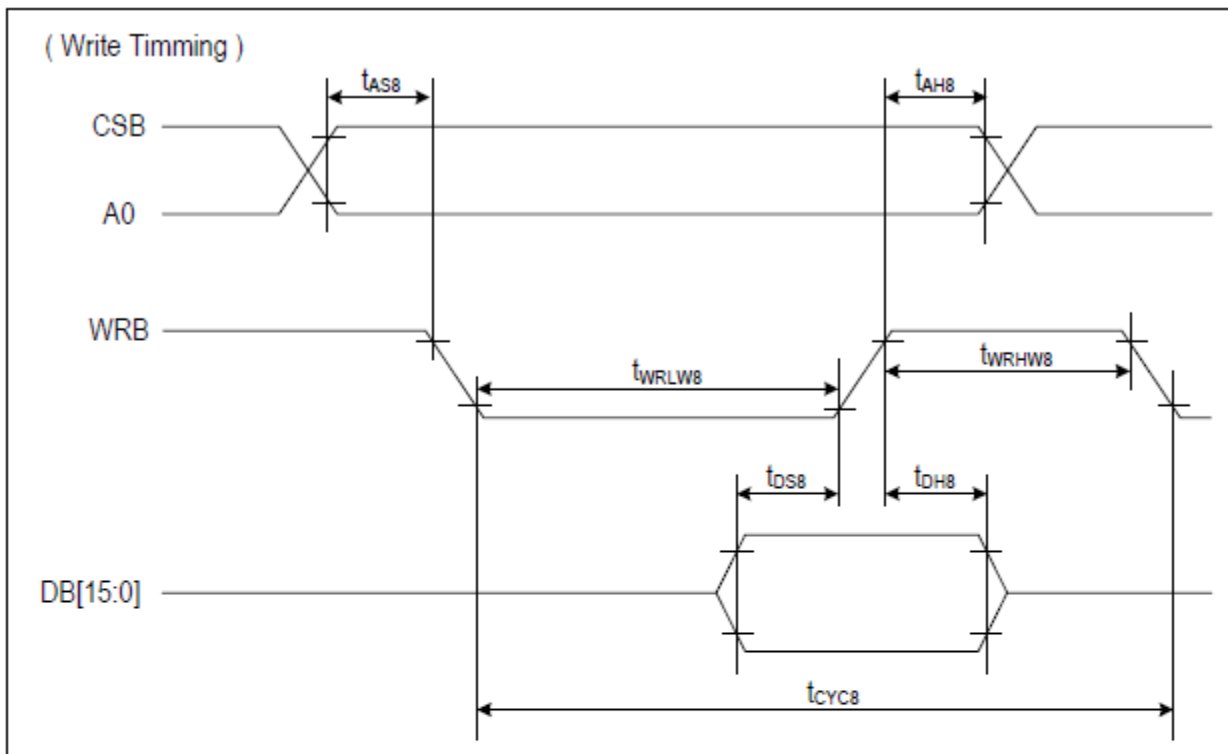


(VDD = 2.8V, Ta = 25°C)

ITEM	SYMBOL	CONDITION	MIN	MAX	UNIT	PORT
Address hold timing	t_{AH6}	-	10	-	ns	CSB
Address setup timing	t_{AS6}	-	10	-	ns	A0
System cycle timing	t_{CYC6}	-	200	-	ns	
Read "L" pulse width	t_{ELR6}	-	90	-	ns	E
Read "H" pulse width	t_{EHR6}	-	90	-	ns	
Read data output delay time	t_{RDD6}	CL = 15 pF	0	70	ns	DB[15:0]
Data hold timing	t_{RDH6}				ns	

Notice) All the timing reference is 10% and 90% of VDDIO.

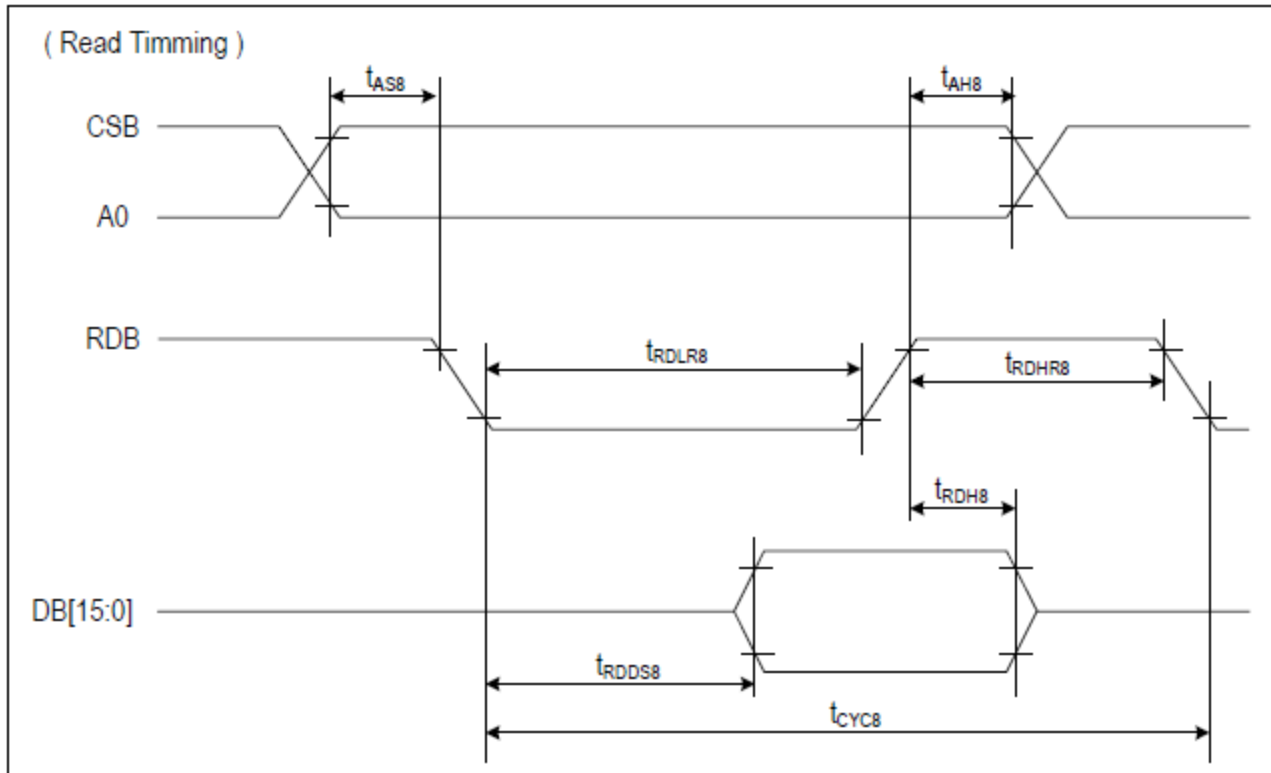
Parallel (8080 mode):



(VDD = 2.8V, Ta = 25°C)

ITEM	SYMBOL	CONDITION	MIN	MAX	UNIT	PORT
Address hold timing	tAH8	-	5	-	ns	CSB
Address setup timing	tAS8	-	5	-	ns	A0
System cycle timing	tCYCS	-	100	-	ns	
Write "L" pulse width	tWRLW8	-	45	-	ns	WRB
Write "H" pulse width	tWRHW8	-	45	-	ns	WRB
Data setup timing	tDS8	-	30	-	ns	DB[15:0]
Data hold timing	tDH8	-	10	-	ns	DB[15:0]

notice) All the timing reference is 10% and 90% of VDDIO.

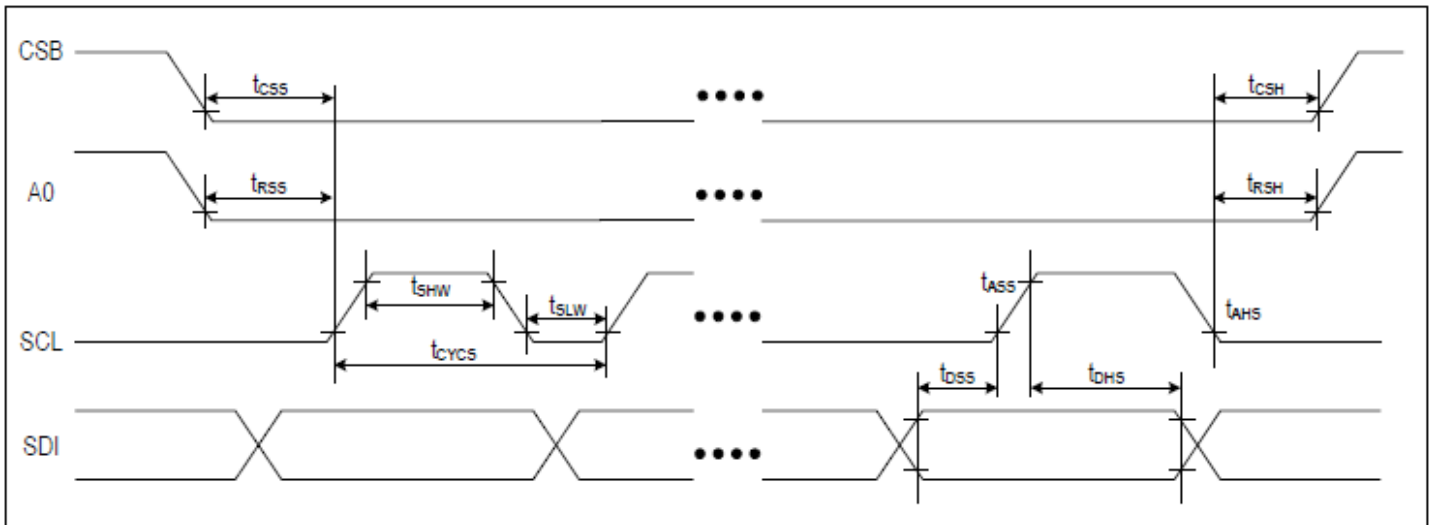


(VDD = 2.8V, Ta = 25°C)

ITEM	SYMBOL	CONDITION	MIN	MAX	UNIT	PORT
Address hold timing	t_{AH8}	-	5	-	ns	CSB
Address setup timing	t_{AS8}	-	5	-	ns	A0
System cycle timing	t_{cyc8}	-	200	-	ns	
Read "L" pulse width	t_{RDLR8}	-	90	-	ns	RDB
Read "H" pulse width	t_{RDHR8}	-	90	-	ns	
Read data output delay time	t_{RDDS8}	CL = 15 pF	-	60	ns	DB[15:0]
Data hold timing	t_{RDH8}		0		ns	

Notice) All the timing reference is 10% and 90% of VDDIO.

4-wire SPI:



(VDD = 2.8V, Ta = 25°C)

ITEM	SYMBOL	CONDITION	MIN	MAX	UNIT	PORT
Serial clock cycle	t_{CYCS}		200		ns	
SCL "H" pulse width	t_{SHW}	-	90	-	ns	SCL
SCL "L" pulse width	t_{SLW}	-	90	-	ns	SCL
Data setup timing	t_{DSS}	-	25	-	ns	SDI
Data hold timing	t_{DHS}	-	25	-	ns	SDI
CSB-SCL timing	t_{CSS}	-	25	-	ns	CSB
CSB-hold timing	t_{CSSH}	-	25	-	ns	CSB
RS-SCL timing	t_{RSS}	-	25	-	ns	RS
RS-hold timing	t_{RSH}	-	25	-	ns	RS

Notice) All the timing reference is 10% and 90% of VDDIO.

Example Initialization Sequence:

```
void OLED_Init_9696RGB(void)
{
  GPIO_ResetBits(RES_pin);
  delay_ms(10);
  GPIO_SetBits(RES_pin);
  delay_ms(10);

  oled_Command_9696RGB(0x01);    //Set SOFT_RESET
  oled_Data_9696RGB(0x00);

  oled_Command_9696RGB(0x14);    //Set STANDBY_ON_OFF
  oled_Data_9696RGB(0x01);

  delay_ms(1);

  oled_Command_9696RGB(0x14);    //Set STANDBY_ON_OFF
  oled_Data_9696RGB(0x01);

  delay_ms(1);

  oled_Command_9696RGB(0x02);    //Set DISP_ON_OFF
  oled_Data_9696RGB(0x00);

  oled_Command_9696RGB(0x0F);    //Set ANALOG_CONTROL
  oled_Data_9696RGB(0x40);

  oled_Command_9696RGB(0x1A);    //Set OSC_ADJUST
  oled_Data_9696RGB(0x40);

  oled_Command_9696RGB(0x30);    //Set DISPLAY_X1
  oled_Data_9696RGB(0x00);

  oled_Command_9696RGB(0x31);    //Set DISPLAY_X2
  oled_Data_9696RGB(0x5F);

  oled_Command_9696RGB(0x32);    //Set DISPLAY_Y1
  oled_Data_9696RGB(0x00);

  oled_Command_9696RGB(0x33);    //Set DISPLAY_Y2
  oled_Data_9696RGB(0x5F);

  oled_Command_9696RGB(0xE0);    //Set RGB_IF
  oled_Data_9696RGB(0x00);

  oled_Command_9696RGB(0xE1);    //Set RGB_POL
  oled_Data_9696RGB(0x00);

  oled_Command_9696RGB(0xE5);    //Set DISPLAY_MODE_CONTROL
  oled_Data_9696RGB(0x80);

  oled_Command_9696RGB(0x0D);    //Set CPU_IF
  oled_Data_9696RGB(0x00);

  oled_Command_9696RGB(0x1D);    //Set MEMORY_WRITE/READ
  oled_Data_9696RGB(0x00);

  oled_Command_9696RGB(0x09);    //Set ROW_SCAN_DIRECTION
  oled_Data_9696RGB(0x00);
}
```

```

oled_Command_9696RGB(0x13); //Set ROW_SCAN_MODE
oled_Data_9696RGB(0x00);

oled_Command_9696RGB(0x40); //Set COLUMN_CURRENT_R
oled_Data_9696RGB(0x6E);

oled_Command_9696RGB(0x41); //Set COLUMN_CURRENT_G
oled_Data_9696RGB(0x4F);

oled_Command_9696RGB(0x42); //Set COLUMN_CURRENT_B
oled_Data_9696RGB(0x77);

oled_Command_9696RGB(0x48); //Set ROW_OVERLAP
oled_Data_9696RGB(0x00);

oled_Command_9696RGB(0x18); //Set DISCHARGE_TIME
oled_Data_9696RGB(0x01);

oled_Command_9696RGB(0x16); //Set PEAK_PULSE_DELAY
oled_Data_9696RGB(0x00);

oled_Command_9696RGB(0x3A); //Set PEAK_PULSE_WIDTH_R
oled_Data_9696RGB(0x02);

oled_Command_9696RGB(0x3B); //Set PEAK_PULSE_WIDTH_G
oled_Data_9696RGB(0x02);

oled_Command_9696RGB(0x3C); //Set PEAK_PULSE_WIDTH_B
oled_Data_9696RGB(0x02);

oled_Command_9696RGB(0x3D); //Set PRECHARGE_CURRENT_R
oled_Data_9696RGB(0x14);

oled_Command_9696RGB(0x3E); //Set PRECHARGE_CURRENT_G
oled_Data_9696RGB(0x50);

oled_Command_9696RGB(0x3F); //Set PRECHARGE_CURRENT_B
oled_Data_9696RGB(0x19);

oled_Command_9696RGB(0x17); //Set ROW_SCAN_ON/OFF
oled_Data_9696RGB(0x00);

oled_Command_9696RGB(0x49); //Set SCAN_OFF_LEVEL
oled_Data_9696RGB(0x04);

oled_Clear_Screen(); //Clear Display

oled_Command_9696RGB(0x38); //Set DISPLAYSTART_X
oled_Data_9696RGB(0x00);

oled_Command_9696RGB(0x39); //Set DISPLAYSTART_Y
oled_Data_9696RGB(0x00);

oled_Command_9696RGB(0x02); //Set DISP_ON_OFF
oled_Data_9696RGB(0x01);

delay_ms(100);

oled_Command_160128RGB(0x08); //Enable write to display RAM
}

```

Quality Information

Test Item	Content of Test	Test Condition	Note
High Temperature storage	Test the endurance of the display at high storage temperature.	+85°C, 240 Hrs.	2
Low Temperature storage	Test the endurance of the display at low storage temperature.	-40°C, 240 Hrs.	1,2
High Temperature Operation	Test the endurance of the display by applying electric stress (voltage & current) at high temperature.	+70°C, 240 Hrs.	2
Low Temperature Operation	Test the endurance of the display by applying electric stress (voltage & current) at low temperature.	-40°C, 240 Hrs.	1,2
High Temperature / Humidity Operation	Test the endurance of the display by applying electric stress (voltage & current) at high temperature with high humidity.	+60°C, 90% RH, 120 Hrs.	1,2
Thermal Shock resistance	Test the endurance of the display by applying electric stress (voltage & current) during a cycle of low and high temperatures.	-40°C, 30 min -> 25°C, 5 min -> 70°C, 30 min = 1 cycle 100 Cycles	
Vibration test	Test the endurance of the display by applying vibration to simulate transportation and use.	10-22Hz , 15mm amplitude. 22-500Hz, 1.5G 30min in each of 3 directions X,Y,Z	3
Atmospheric Pressure test	Test the endurance of the display by applying atmospheric pressure to simulate transportation by air.	115mbar, 40hrs	3
Static electricity test	Test the endurance of the display by applying electric static discharge.	V _s =800V, R _s =1.5kΩ, C _s =100pF One time	

Note 1: No condensation to be observed.

Note 2: Conducted after 2 hours of storage at 25°C, 0%RH.

Note 3: Test performed on product itself, not inside a container.

Evaluation Criteria:

- 1: Display is fully functional during operational tests and after all tests, at room temperature.
- 2: No observable defects.
- 3: Luminance >50% of initial value.
- 4: Current consumption within 50% of initial value

Precautions for using OLEDs/LCDs/LCMs

See Precautions at www.newhavendisplay.com/specs/precautions.pdf

Warranty Information

See Terms & Conditions at http://www.newhavendisplay.com/index.php?main_page=terms