NHD-2.7-12864UCY3

Graphic OLED Display Module

NHD-	Newhaven Display
2.7-	2.7” diagonal size
12864-	128 x 64 pixel resolution
UC-	Model
Y-	Emitting Color: Yellow
3-	+3V power supply

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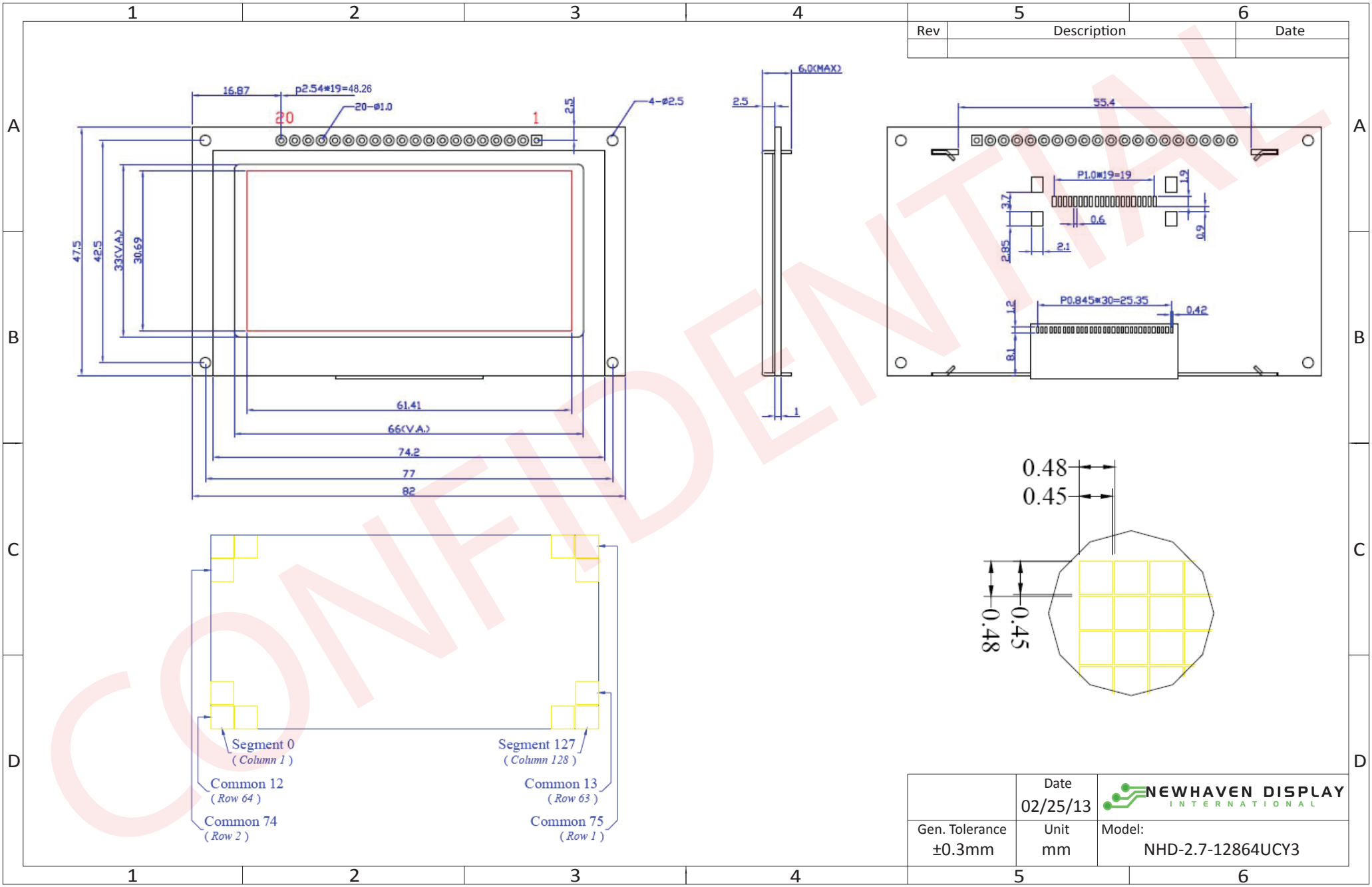
Document Revision History

Revision	Date	Description	Changed by
0	5/1/2011	Initial Product Release	-
1	7/01/2011	Updated Pin Measurement on Mechanical Drawing	MC
2	2/25/2013	Electrical characteristics and mechanical drawing updated	JN

Functions and Features

- **128 x 64 pixel resolution**
- **Built-in SSD1325 controller**
- **Parallel or serial MPU interface**
- **Single, low voltage power supply**
- **RoHS compliant**

Mechanical Drawing



Interface Description

Parallel Interface:

Pin No.	Symbol	External Connection	Function Description
1	VSS	Power Supply	Ground
2	VDD	Power Supply	Supply Voltage for OLED and logic.
3	NC	-	No Connect
4	D/C	MPU	Register select signal. D/C=0: Command, D/C=1: Data
5	R/W 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. Falling edge triggered. **8080-interface:** Active LOW Read signal.
7-14	DB0 – DB7	MPU	8-bit Bi-directional data bus lines.
15	NC	-	No Connect
16	/RES	MPU	Active LOW Reset signal.
17	/CS	MPU	Active LOW Chip Select signal.
18	NC	-	No Connect
19	BS2	MPU	MPU Interface Select signal.
20	BS1	MPU	MPU Interface Select signal.

Serial Interface:

Pin No.	Symbol	External Connection	Function Description
1	VSS	Power Supply	Ground
2	VDD	Power Supply	Supply Voltage for OLED and logic.
3	NC	-	No Connect
4	D/C	MPU	Register select signal. D/C=0: Command, D/C=1: Data
5-6	VSS	Power Supply	Ground
7	SCLK	MPU	Serial Clock signal.
8	SDIN	MPU	Serial Data Input signal.
9	NC	-	No Connect
10-14	VSS	Power Supply	Ground
15	NC	-	No Connect
16	/RES	MPU	Active LOW Reset signal.
17	/CS	MPU	Active LOW Chip Select signal.
18	NC	-	No Connect
19	BS2	MPU	MPU Interface Select signal.
20	BS1	MPU	MPU Interface Select signal.

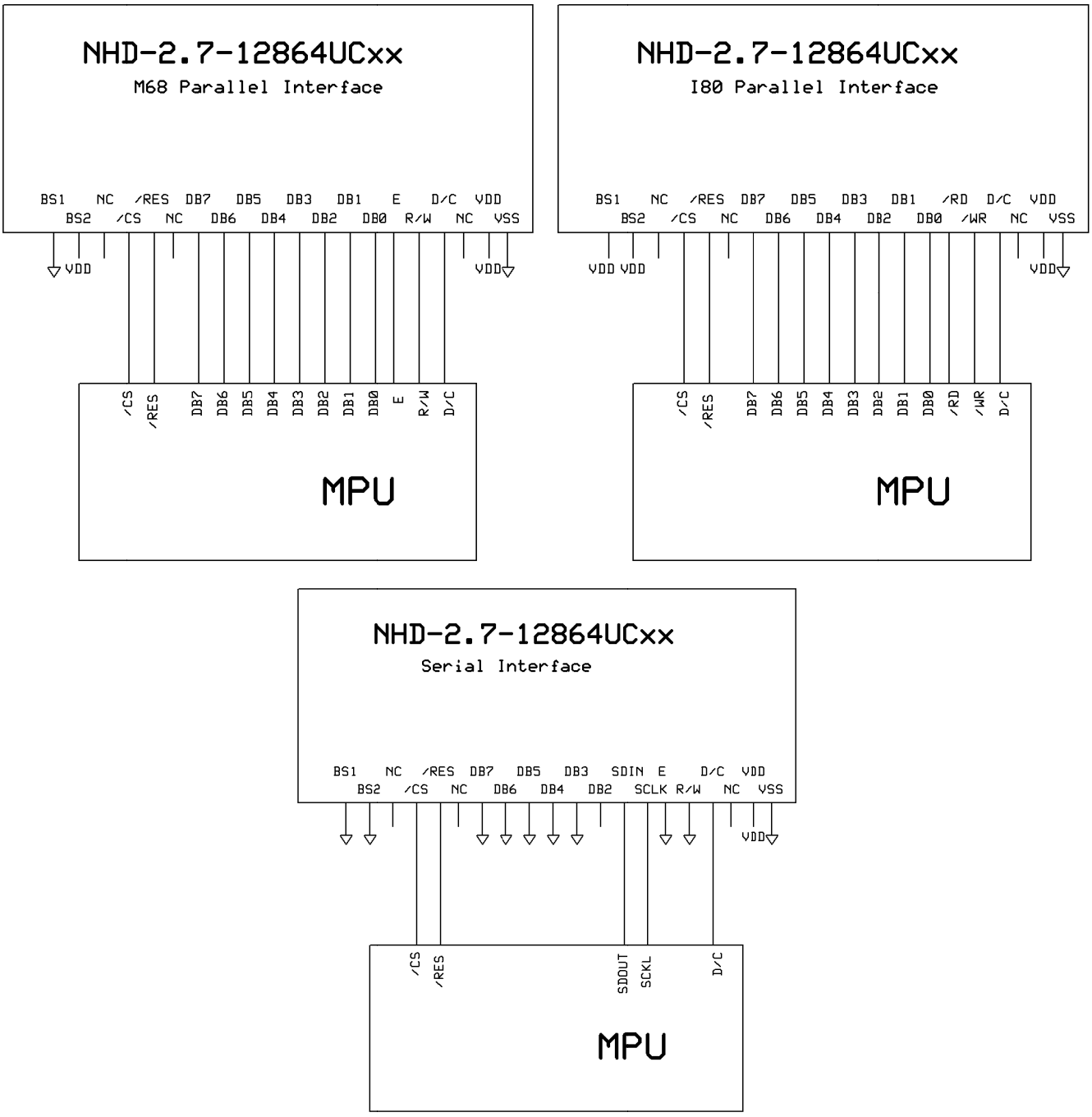
MPU Interface Pin Selections

Pin Name	6800 Parallel 8-bit interface	8080 Parallel 8-bit interface	Serial Interface
BS2	1	1	0
BS1	0	1	0

MPU Interface Pin Assignment Summery

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 Diagrams



Electrical Characteristics

Item	Symbol	Condition	Min.	Typ.	Max.	Unit
Operating Temperature Range	Top	Absolute Max	-40	-	+85	°C
Storage Temperature Range	Tst	Absolute Max	-40	-	+90	°C
Supply Voltage	VDD		-	3.3	3.5	V
Supply Current (logic)	IDD	Ta=25°C, VDD=3.3V	-	4	4	mA
Supply Current (display)	ICC	50% ON, VDD=3.3V	-	175	185	mA
		100% ON, VDD=3.3V	-	295	310	mA
Sleep Mode Current	$IDD+ICC_{SLEEP}$		-	2	10	µA
"H" Level input	Vih		0.8*VDD	-	VDD	V
"L" Level input	Vil		VSS	-	0.2*VDD	V
"H" Level output	Voh		0.9*VDD	-	VDD	V
"L" Level output	Vol		VSS	-	0.1*VDD	V

Optical Characteristics

Item	Symbol	Condition	Min.	Typ.	Max.	Unit
Viewing Angle – Top	AV		-	80	-	º
Viewing Angle – Bottom	AV		-	80	-	º
Viewing Angle – Left	AH		-	80	-	º
Viewing Angle – Right	AH		-	80	-	º
Contrast Ratio	Cr		2000:1	-	-	-
Response Time (rise)	Tr	-	-	10	-	us
Response Time (fall)	Tf	-	-	10	-	us
Brightness		50% checkerboard	70	100	-	cd/m^2
Lifetime		Ta=25°C, 50% checkerboard	40,000	-	-	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.

Built-in SSD1325 controller
Instruction Table

Instruction	Code										Description	RESET value
	D/C	HEX	DB7	DB6	DB5	DB4	DB3	DB2	DB1	DB0		
Set Column Address	0 0 0	**15** **A[5:0]** **B[5:0]**	**0** * *	**0** * *	**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[5:0]: Column start address. Range: 0-63d B[5:0]: Column end address. Range: 0-63d	 0 63d
Set Row Address	0 0 0	**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: 0-79d B[6:0]: Row end address. Range: 0-79d	 0 79d
Set Contrast Control	0 0	**81** **A[6:0]**	**1** *	**0** **A6**	**0** **A5**	**0** **A4**	**0** **A3**	**0** **A2**	**0** **A1**	**1** **A0**	Double byte command to select 1 out of 128 contrast steps. Contrast increases as the value increases.	 0x40
Set Current Range	0	**84~86**	**1**	**0**	**0**	**0**	**0**	**1**	**X1**	**X0**	0x84 = Quarter Current Range 0x85 = Half Current Range 0x86 = Full Current Range	0x84
Set Remap	0 0	**A0** **A[6:0]**	**1** *	**0** **A6**	**1** *	**0** **A4**	**0** *	**0** **A2**	**0** **A1**	**0** **A0**	A[0] = 0; Disable Column Address remap A[0] = 1; Enable Column Address remap A[1] = 0; Disable Nibble remap A[1] = 1; Enable Nibble remap A[2] = 0; Horizontal Address Increment A[2] = 1; Vertical Address Increment A[4] = 0; Disable COM remap A[4] = 1; Enable COM A[6] = 0; Disable COM split Odd/Even A[6] = 1; Enable COM split Odd/Even	0 0 0 0 0
Set Display Start Line	0 0	**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 0-79.	0
Set Display Offset	0 0	**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 0~79.	0
Display Mode	0	**A4/A7**	**1**	**0**	**1**	**0**	**0**	**X2**	**X1**	**X0**	0xA4 = Normal display 0xA5 = Entire display ON, all pixels Grayscale level 15 0xA6 = Entire display OFF 0xA7 = Inverse display	0xA4
Set Multiplex Ratio	0 0	**A8** **A[6:0]**	**1** *	**0** **A6**	**1** **A5**	**0** **A4**	**1** **A3**	**0** **A2**	**0** **A1**	**0** **A0**	Set MUX ratio to N+1 MUX N=A[6:0]; from 16MUX to 80MUX (0 to 14 are invalid)	80
Master configuration	0 0	**AD** **A[1:0]**	**1** *	**0** *	**1** *	**0** *	**1** *	**1** *	**0** **A1**	**1** **A0**	A[0] = 0; Disable DC-DC converter A[0] = 1; Enable DC-DC converter A[1] = 0; Disable internal VCOMH A[1] = 1; Enable internal VCOMH	 1 1
Set Display ON/ OFF	0	**AE~AF**	**1**	**0**	**1**	**0**	**X3**	**1**	**1**	**1**	0xAE = Display OFF (sleep mode) 0xAF = Display ON	AEh

Set VCOMH Voltage	0 0	**BE** **A[5:0]**	**1** *	**0** *	**1** **A5**	**1** **A4**	**1** **A3**	**1** **A2**	**1** **A1**	**0** **A0**	Sets the VCOMH voltage level 000000-011111. A[5:0] = 1xxxxx = 1.0*VREF	010001
Set Precharge Voltage	0 0	**BC** **A[7:0]**	**1** **A7**	**0** **A6**	**1** **A5**	**1** **A4**	**1** **A3**	**1** **A2**	**0** **A1**	**0** **A0**	Sets the precharge voltage level 00000000-00011111 A[7:0] = 1xxxxxxx connects to VCOMH A[7:0] = 001xxxxx equals 1.0*VREF	00011000
Set Phase Length	0 0 0	**B1** **A[3:0]** **A[7:4]**	**1** * **A7**	**0** * **A6**	**1** * **A5**	**1** * **A4**	**0** **A3** *	**0** **A2** *	**0** **A1** *	**1** **A0** *	 A[3:0] = P1. Phase 1 period of 1-15 DCLK clocks A[7:4] = P2. Phase 2 period of 1-15 DCLK clocks	 3 5
Set Row Period	0 0	**B2** **A[7:0]**	**1** **A7**	**0** **A6**	**1** **A5**	**1** **A4**	**0** **A3**	**0** **A2**	**1** **A1**	**0** **A0**	Sets number of DCLKs (K) per row. Range 2-158DCLKs. K = P1 + P2 + GS15 pulse width (RESET values: 3 + 5 + 29)	37DCLKs (0x25)
Set Display Clock Divide Ratio / Oscillator Frequency	0 0 0	**B3** **A[3:0]** **A[7:4]**	**1** * **A7**	**0** * **A6**	**1** * **A5**	**1** * **A4**	**0** **A3** *	**0** **A2** *	**1** **A1** *	**1** **A0** *	A[3:0] = Define the divide ratio of the display clocks. Range 1-16 Divide ratio = A[3:0] +1 A[7:4] = Set the Oscillator Frequency. Frequency increases with the value of A[7:4]. Range 0000b~1111b.	2 0
Set Grayscale Table	0 0 0 0 0 0 0 0 0 0 0 0 0 0	**B8** **A[2:0]** **B[2:0]** **B[6:4]** **C[2:0]** **C[6:4]** **D[2:0]** **D[6:4]** **E[2:0]** **E[6:4]** **F[2:0]** **F[6:4]** **G[2:0]** **G[6:4]** **H[2:0]** **H[6:4]**	**1** * * * * * * * * * * * * * * *	**0** * * **B6** * **C6** * **D6** * **E6** * **F6** * **G6** * **H6**	**0** * * **B5** * **C5** * **D5** * **E5** * **F5** * **G5** * **H5**	**0** * * **B4** * **C4** * **D4** * **E4** * **F4** * **G4** * **H4**	**1** * * * * * * * * * * * * * * *	**0** **A2** **B2** * **C2** * **D2** * **E2** * **F2** * **G2** * **H2** *	**0** **A1** **B1** * **C1** * **D1** * **E1** * **F1** * **G1** * **H1** *	**0** **A0** **B0** * **C0** * **D0** * **E0** * **F0** * **G0** * **H0** *	Sets the gray scale level. Range 1-15 A[2:0] = L1 B[2:0] = L2 B[6:4] = L3 C[2:0] = L4 C[6:4] = L5 D[2:0] = L6 D[6:4] = L7 E[2:0] = L8 E[6:4] = L9 F[2:0] = L10 F[6:4] = L11 G[2:0] = L12 G[6:4] = L13 H[2:0] = L14 H[6:4] = L15	 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1
Set Biasing Current for DC-DC converter	0 0	**CF** **A[7:6]**	**1** **A7**	**1** **A6**	**0** *	**0** *	**1** *	**1** *	**1** *	**1** *	0xF0 = HIGH 0x70 = LOW	0xF0
NOP	0	**E3**	**1**	**1**	**1**	**0**	**0**	**0**	**1**	**1**	Command for No Operation	

For detailed instruction information, see datasheet: http://www.newhavendisplay.com/app_notes/SSD1325.pdf

MPU Interface

For detailed timing information, see datasheet: http://www.newhavendisplay.com/app_notes/SSD1325.pdf

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

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

Alternatively, /RD and /WR can be kept stable while /CS serves as the data/command latch signal.

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

Serial Interface

The serial interface consists of serial clock SCLK, serial data SDIN, D/C, and /CS.
D0 acts as SCLK and D1 acts as SDIN. D2 should be left open. D3~D7, E, and R/W should be connected to GND.

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

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 GDRAM or command register in the same clock.
Note: Read is not available in serial mode.

For detailed protocol information, see datasheet: http://www.newhavendisplay.com/app_notes/SSD1325.pdf

Example Initialization Sequence:

```
Set_Display_On_Off_12864(0x00);                 // Display Off (0x00/0x01)
Set_Display_Clock_12864(0x91);                  // Set Clock as 135 Frames/Sec
Set_Multiplex_Ratio_12864(0x3F);                // 1/64 Duty (0x0F~0x5F)
Set_Display_Offset_12864(0x4C);                 // Shift Mapping RAM Counter (0x00~0x5F)
Set_Start_Line_12864(0x00);                     // Set Mapping RAM Display Start Line (0x00~0x5F)
Set_Master_Config_12864(0x00);                  // Disable Embedded DC/DC Converter (0x00/0x01)
Set_Remap_Format_12864(0x50);                   // Set Column Address 0 Mapped to SEG0
                                                //    Disable Nibble Remap
                                                //    Horizontal Address Increment
                                                //    Scan from COM[N-1] to COM0
                                                //    Enable COM Split Odd Even
Set_Current_Range_12864(0x02);                  // Set Full Current Range
Set_Gray_Scale_Table_12864();                   // Set Pulse Width for Gray Scale Table
Set_Contrast_Current_12864(brightness);         // Set Scale Factor of Segment Output Current Control
Set_Frame_Frequency_12864(0x51);                // Set Frame Frequency
Set_Phase_Length_12864(0x55);                   // Set Phase 1 as 5 Clocks & Phase 2 as 5 Clocks
Set_Precharge_Voltage_12864(0x10);              // Set Pre-Charge Voltage Level
Set_Precharge_Compensation_12864(0x20,0x02);        // Set Pre-Charge Compensation
Set_VCOMH_12864(0x1C);                          // Set High Voltage Level of COM Pin
Set_VSL_12864(0x0D);                            // Set Low Voltage Level of SEG Pin
Set_Display_Mode_12864(0x00);                   // Normal Display Mode (0x00/0x01/0x02/0x03)
Fill_RAM_12864(0x00);                           // Clear Screen
Set_Display_On_Off_12864(0x01);                 // Display On (0x00/0x01)
```

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.	+60°C , 90% RH , 240hrs	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 -> 25°C,5min -> 85°C,30min = 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.	VS=800V, RS=1.5kΩ, CS=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 and Terms & Conditions

http://www.newhavendisplay.com/index.php?main_page=terms

Newhaven Display International, Inc. reserves the right to alter this product or specification at any time without notification.