

NHD-1.27-AU-SHIELD

Graphic Color OLED Display Module + Arduino UNO Shield

NHD-	Newhaven Display
1.27-	1.27" Diagonal Size
AU-	Arduino Uno
SHIELD-	Shield

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

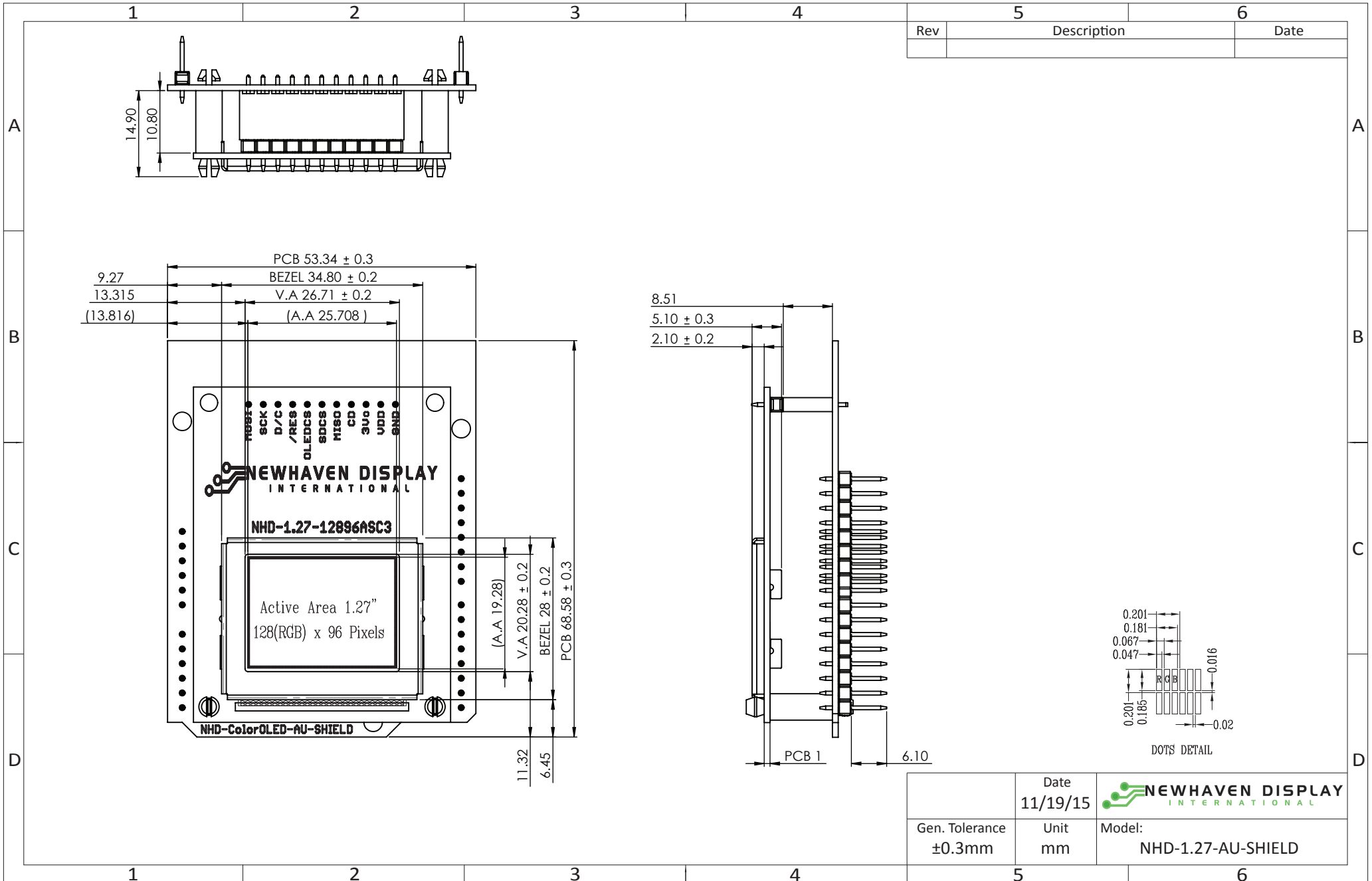
Document Revision History

Revision	Date	Description	Changed by
0	11/19/2015	Initial Release	PB
1	1/11/2016	Functions and Features Updated	PB


Functions and Features

- 128 x 96 pixel resolution
- Built-in SSD1351 controller
- SPI MPU interface
- RoHS compliant
- microSD card reader (microSD card not included)
- Built-in logic level shifting for 3.3V ~ 5V operation

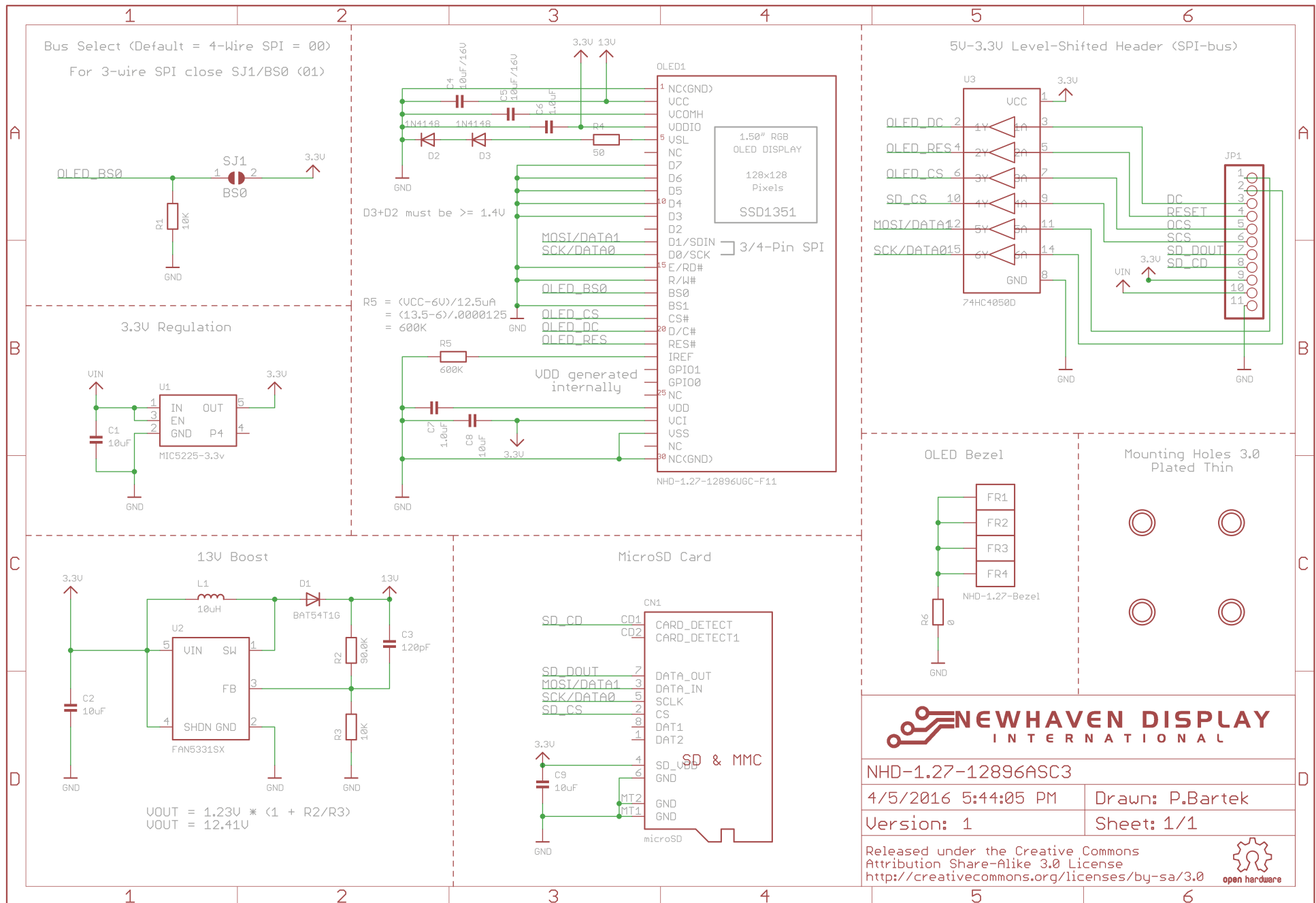
Mechanical Drawing

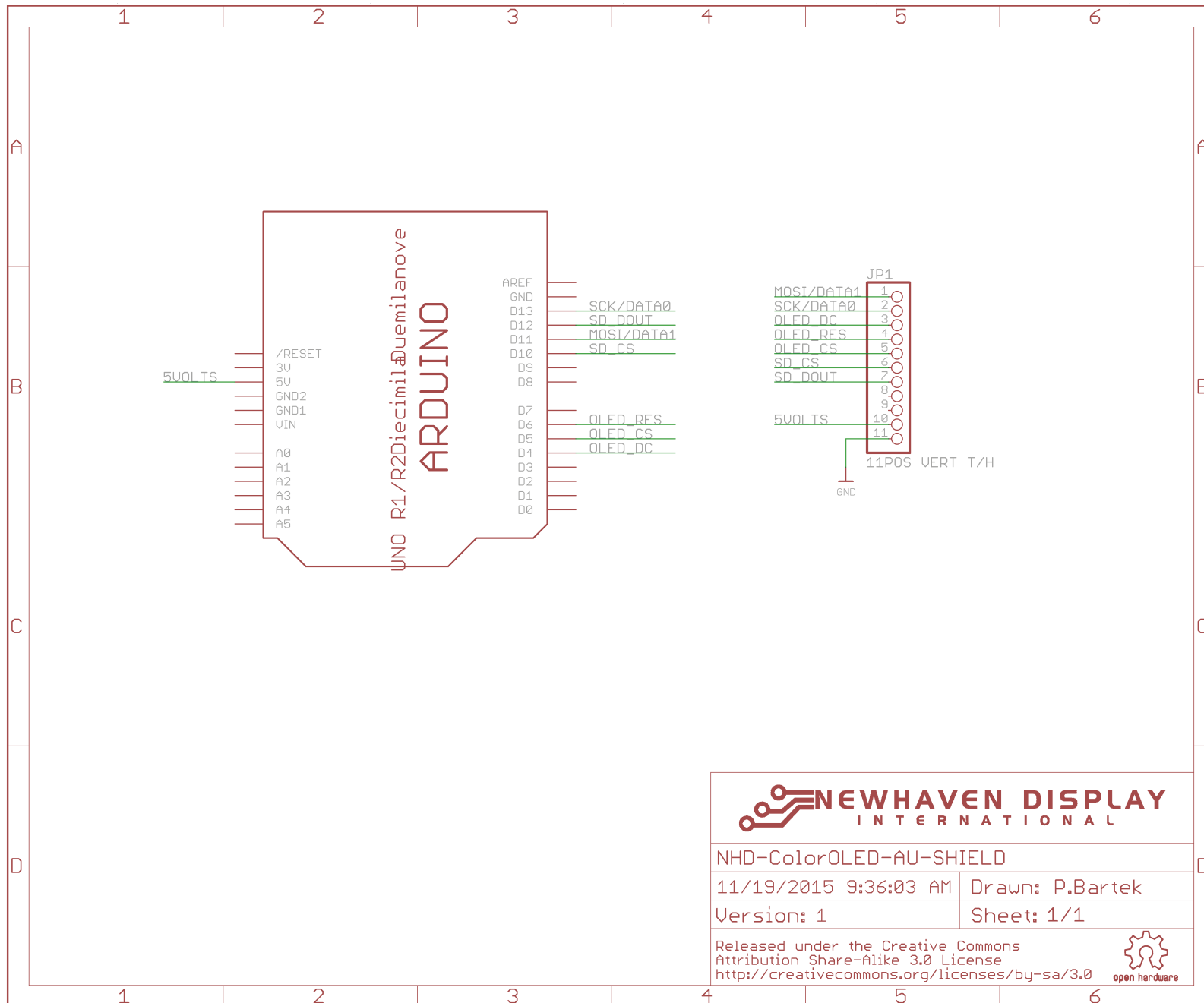



Rev	Description	Date

	Date 11/19/15	 NEWHAVEN DISPLAY INTERNATIONAL Model: NHD-1.27-AU-SHIELD
Gen. Tolerance ±0.3mm	Unit mm	

Schematic





NHD-ColorOLED-AU-SHIELD	
11/19/2015 9:36:03 AM	Drawn: P.Bartek
Version: 1	Sheet: 1/1
Released under the Creative Commons Attribution Share-Alike 3.0 License http://creativecommons.org/licenses/by-sa/3.0	
 open hardware	

Interface Description

JP1 Interface:

Pin No.	Symbol	External Connection	Function Description
1	MOSI	MPU	Master Out Slave In
2	SCK	MPU	Serial Clock signal
3	D/C	MPU	Register Select signal. D/C=0: Command, D/C=1: Data
4	/RES	MPU	Active LOW Reset signal
5	OLEDCS	MPU	OLED Active LOW Chip Select signal
6	SDCS	MPU	Micro SD Active LOW Chip Select signal
7	MISO	MPU	Master In / Slave Out
8	NC	-	No Connect
9	NC	-	No Connect
10	VDD	Power Supply	Supply Voltage for OLED and logic (3.3V~5V)
11	GND	Power Supply	Ground

JP2 Interface:

Shield Pin Symbol	Arduino UNO Pin Symbol	Function Description
AREF	AREF	No Connect
GND	GND	Ground
Digital 13	13	Serial Clock signal
Digital 12	12	Master In / Slave Out
Digital 11	11	Master Out Slave In
Digital 10	10	Micro SD Active LOW Chip Select signal
Digital 9	9	No Connect
Digital 8	8	No Connect

JP3 Interface:

Shield Pin Symbol	Arduino UNO Pin Symbol	Function Description
Digital 7	7	No Connect
Digital 6	6	Active LOW Reset signal
Digital 5	5	OLED Active LOW Chip Select signal
Digital 4	4	Register Select signal. D/C=0: Command, D/C=1: Data
Digital 3	3	No Connect
Digital 2	2	No Connect
Digital 1	1	No Connect
Digital 0	0	No Connect

JP4 Interface:

Shield Pin Symbol	Arduino UNO Pin Symbol	Function Description
Analog 5	A5	No Connect
Analog 4	A4	No Connect
Analog 3	A3	No Connect
Analog 2	A2	No Connect
Analog 1	A1	No Connect
Analog 0	A0	No Connect

JP5 Interface:

Shield Pin Symbol	Arduino UNO Pin Symbol	Function Description
RST	RESET	No Connect
3V	3.3V	No Connect
5V	5V	Supply Voltage for OLED and logic (5V)
GND	GND	No Connect
GND	GND	No Connect
Vin	Vin	No Connect

Electrical Characteristics

Item	Symbol	Condition	Min.	Typ.	Max.	Unit
Operating Temperature Range	Top	Absolute Max	-30	-	+70	°C
Storage Temperature Range	Tst	Absolute Max	-40	-	+80	°C
Supply Voltage	VDD		3.0	3.3	5.5	V
Supply Current	IDD		-	80	200	mA
"H" Level input	Vih		0.8*VDD	-	VDD	V
"L" Level input	Vil		0	-	0.2*VDD	V
"H" Level output	Voh		0.9*VDD	-	VDD	V
"L" Level output	Vol		0	-	0.1*VDD	V

Optical Characteristics

Item	Symbol	Condition	Min.	Typ.	Max.	Unit
Viewing Angle – Top			80	-	-	°
Viewing Angle – Bottom			80	-	-	°
Viewing Angle – Left			80	-	-	°
Viewing Angle – Right			80	-	-	°
Contrast Ratio	Cr		-	2000:1	-	-
Response Time (rise)	Tr	-	-	10	-	us
Response Time (fall)	Tf	-	-	10	-	us
Brightness		50% checkerboard	60	75	-	cd/m ²
Lifetime		90 cd/m ² , Ta=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 SSD1351 controller.

Please download specification at www.newhavendisplay.com/app_notes/SSD1351.pdf

Table of Commands

(D/C# = 0, R/W#(WR#)= 0, E(RD#) = 1) unless specific setting is stated

Single byte command (D/C# = 0), Multiple byte command (D/C# = 0 for first byte, D/C# = 1 for other bytes)

Fundamental Command Table											
D/C#	Hex	D7	D6	D5	D4	D3	D2	D1	D0	Command	Description
0	15	0	0	0	1	0	1	0	1	Set Column Address	A[6:0]: Start Address. [reset=0] B[6:0]: End Address. [reset=127] Range from 0 to 127
1	A[6:0]	*	A ₆	A ₅	A ₄	A ₃	A ₂	A ₁	A ₀		
1	B[6:0]	*	B ₆	B ₅	B ₄	B ₃	B ₂	B ₁	B ₀		
0	75	0	1	1	1	0	1	0	1	Set Row Address	A[6:0]: Start Address. [reset=0] B[6:0]: End Address. [reset=127] Range from 0 to 127
1	A[6:0]	*	A ₆	A ₅	A ₄	A ₃	A ₂	A ₁	A ₀		
1	B[6:0]	*	B ₆	B ₅	B ₄	B ₃	B ₂	B ₁	B ₀		
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	A0	1	0	1	0	0	0	0	0	Set Re-map / Color Depth (Display RAM to Panel)	A[0]=0b, Horizontal address increment [reset] A[0]=1b, Vertical address increment
1	A[7:0]	A ₇	A ₆	A ₅	A ₄	A ₃	A ₂	A ₁	A ₀		A[1]=0b, Column address 0 is mapped to SEG0 [reset] A[1]=1b, Column address 127 is mapped to SEG0 A[2]=0b, Color sequence: A → B → C [reset] A[2]=1b, Color sequence is swapped: C → B → A A[3]=0b, Reserved A[3]=1b, Reserved A[4]=0b, Scan from COM0 to COM[N-1] [reset] A[4]=1b, Scan from COM[N-1] to COM0. Where N is the Multiplex ratio. A[5]=0b, Disable COM Split Odd Even A[5]=1b, Enable COM Split Odd Even [reset] A[7:6] Set Color Depth, 00b / 01b: 65k color [reset] 10b: 262k color 11b 262k color, 16-bit format 2 Refer to Table 8-8 for details

Fundamental Command Table											
D/C#	Hex	D7	D6	D5	D4	D3	D2	D1	D0	Command	Description
0 1	A1 A[6:0]	1 *	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 vertical scroll by RAM from 0~127. [reset=00h]
0 1	A2 A[6:0]	1 *	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 scroll by Row from 0-127. [reset=60h] Note (1) This command is locked by Command FDh by default. To unlock it, please refer to Command FDh.
0	A4~A7	1	0	1	0	0	1	X ₁	X ₀	Set Display Mode	A4h: All OFF A5h: All ON (All pixels have GS63) A6h : Reset to normal display [reset] A7h: Inverse Display (GS0 -> GS63, GS1 -> GS62,)
0 1	AB A[7:0]	1 A ₇	0 A ₆	1 0	0 0	1 0	0 0	1 0	1 A ₀	Function Selection	A[0]=0b, Select external V _{DD} A[0]=1b, Enable internal V _{DD} regulator [reset] A[7:6]=00b, Select 8-bit parallel interface [reset] A[7:6]=01b, Select 16-bit parallel interface A[7:6]=11b, Select 18-bit parallel interface
0	AD	1	0	1	0	1	1	0	1	NOP	Command for no operation.
0	AE~AF	1	0	1	0	1	1	1	X ₀	Set Sleep mode ON/OFF	AEh = Sleep mode On (Display OFF) AFh = Sleep mode OFF (Display ON)
0	B0	1	0	1	1	0	0	0	0	NOP	Command for no operation.
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	Set Reset (Phase 1) / Pre-charge (Phase 2) period	A[3:0] Phase 1 period of 5~31 DCLK(s) clocks [reset=0010b] A[3:0]: 0-1 invalid 2 = 5 DCLKs 3 = 7 DCLKs : 15 = 31DCLKs A[7:4] Phase 2 period of 3~15 DCLK(s) clocks [reset=1000b] A[7:4]: 0-2 invalid 3 = 3 DCLKs 4 = 4 DCLKs : 15 = 15DCLKs Note (1) 0 DCLK is invalid in phase 1 & phase 2 (2) This command is locked by Command FDh by default. To unlock it, please refer to Command FDh.

Fundamental Command Table																																					
D/C#	Hex	D7	D6	D5	D4	D3	D2	D1	D0	Command	Description																										
0	B2	1	0	1	1	0	0	1	0	Display Enhancement	A[7:0] = 00h, B[7:0] = 00h, C[7:0] = 00h normal [reset] A[7:0] = A4h, B[7:0] = 00h, C[7:0] = 00h enhance display performance																										
1	A[7:0]	A ₇	A ₆	A ₅	A ₄	A ₃	A ₂	A ₁	A ₀																												
1	B[7:0]	0	0	0	0	0	0	0	0																												
1	C[7:0]	0	0	0	0	0	0	0	0																												
0	B3	1	0	1	1	0	0	1	1	Front Clock Divider (DivSet)/ Oscillator Frequency	A[3:0] [reset=0001], divide by DIVSET where <table border="1"> <thead> <tr> <th>A[3:0]</th> <th>DIVSET</th> </tr> </thead> <tbody> <tr><td>0000</td><td>divide by 1</td></tr> <tr><td>0001</td><td>divide by 2</td></tr> <tr><td>0010</td><td>divide by 4</td></tr> <tr><td>0011</td><td>divide by 8</td></tr> <tr><td>0100</td><td>divide by 16</td></tr> <tr><td>0101</td><td>divide by 32</td></tr> <tr><td>0110</td><td>divide by 64</td></tr> <tr><td>0111</td><td>divide by 128</td></tr> <tr><td>1000</td><td>divide by 256</td></tr> <tr><td>1001</td><td>divide by 512</td></tr> <tr><td>1010</td><td>divide by 1024</td></tr> <tr><td>>=1011</td><td>invalid</td></tr> </tbody> </table> A[7:4] Oscillator frequency, frequency increases as level increases [reset=1101b] Note (1) This command is locked by Command FDh by default. To unlock it, please refer to Command FDh.	A[3:0]	DIVSET	0000	divide by 1	0001	divide by 2	0010	divide by 4	0011	divide by 8	0100	divide by 16	0101	divide by 32	0110	divide by 64	0111	divide by 128	1000	divide by 256	1001	divide by 512	1010	divide by 1024	>=1011	invalid
A[3:0]	DIVSET																																				
0000	divide by 1																																				
0001	divide by 2																																				
0010	divide by 4																																				
0011	divide by 8																																				
0100	divide by 16																																				
0101	divide by 32																																				
0110	divide by 64																																				
0111	divide by 128																																				
1000	divide by 256																																				
1001	divide by 512																																				
1010	divide by 1024																																				
>=1011	invalid																																				
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 Segment Low Voltage (VSL)	A[1:0]=00 External VSL [reset] A[1:0]=01,10,11 are invalid Note (1) When external VSL is enabled, in order to avoid distortion in display pattern, an external circuit is needed to connect between VSL and V _{SS} as shown in Figure 14-1.																										
1	A[7:0]	1	0	1	0	0	0	A ₁	A ₀																												
1	B[7:0]	1	0	1	1	0	1	0	1																												
1	C[7:0]	0	1	0	1	0	1	0	1																												
0	B5	1	0	1	1	0	1	0	1	Set GPIO	A[1:0] GPIO0: 00 pin HiZ, Input disabled 01 pin HiZ, Input enabled 10 pin output LOW [reset] 11 pin output HIGH A[3:2] GPIO1: 00 pin HiZ, Input disabled 01 pin HiZ, Input enabled 10 pin output LOW [reset] 11 pin output HIGH																										
1	A[3:0]	*	*	*	*	A ₃	A ₂	A ₁	A ₀																												
0	B6	1	0	1	1	0	1	0	0	Set Second Pre-charge Period	A[3:0] Set Second Pre-charge Period 0000b invalid 0001b 1 DCLKS 0010b 2 DCLKS 1000 8 DCLKS [reset] 1111 15 DCLKS																										
1	A[3:0]	*	*	*	*	A ₃	A ₂	A ₁	A ₀																												

Fundamental Command Table																													
D/C#	Hex	D7	D6	D5	D4	D3	D2	D1	D0	Command	Description																		
0	B8	1	0	1	1	1	0	0	0	Look Up Table for Gray Scale Pulse width	<p>The next 63 data bytes define Gray Scale (GS) Table by setting the gray scale pulse width in unit of DCLK's (ranges from 0d ~ 180d)</p> <p>A1[7:0]: Gamma Setting for GS1, A2[7:0]: Gamma Setting for GS2, : A62[7:0]: Gamma Setting for GS62, A63[7:0]: Gamma Setting for GS63</p> <p>Note ⁽¹⁾ 0 ≤ Setting of GS1 < Setting of GS2 < Setting of GS3..... < Setting of GS62 < Setting of GS63 ⁽²⁾ GS0 has only pre-charge but no current drive stages. ⁽³⁾ GS1 can be set as only pre-charge but no current drive stage by input gamma setting for GS1 equals 0.</p>																		
1	A1[7:0]	A1 ₇	A1 ₆	A1 ₅	A1 ₄	A1 ₃	A1 ₂	A1 ₁	A1 ₀																				
1	A2[7:0]	A2 ₇	A2 ₆	A2 ₅	A2 ₄	A2 ₃	A2 ₂	A2 ₁	A2 ₀																				
1																				
1																				
1																				
1	A62[7:0]	A62 ₇	A62 ₆	A62 ₅	A62 ₄	A62 ₃	A62 ₂	A62 ₁	A62 ₀																				
1	A63[7:0]	A63 ₇	A63 ₆	A63 ₅	A63 ₄	A63 ₃	A63 ₂	A63 ₁	A63 ₀																				
0	B9	1	0	1	1	1	0	0	1	Use Built-in Linear LUT [reset= linear]	Reset to default Look Up Table: GS1 = 0 DCLK GS2 = 2 DCLK GS3 = 4 DCLK GS4 = 6 DCLK ... GS62 = 122 DCLK GS63 = 124 DCLK																		
0	BB	1	0	1	1	1	0	1	1	Set Pre-charge voltage	Set pre-charge voltage level.[reset = 17h]																		
1	A[4:0]	0	0	0	A ₄	A ₃	A ₂	A ₁	A ₀																				
											<table border="1"> <thead> <tr> <th>A[4:0]</th> <th>Hex code</th> <th>pre-charge voltage</th> </tr> </thead> <tbody> <tr> <td>00000</td> <td>00h</td> <td>0.20 x V_{CC}</td> </tr> <tr> <td>:</td> <td>:</td> <td>:</td> </tr> <tr> <td>11111</td> <td>1Fh</td> <td>0.60 x V_{CC}</td> </tr> </tbody> </table> <p>Note ⁽¹⁾This command is locked by Command FDh by default. To unlock it, please refer to Command FDh.</p>	A[4:0]	Hex code	pre-charge voltage	00000	00h	0.20 x V _{CC}	:	:	:	11111	1Fh	0.60 x V _{CC}						
A[4:0]	Hex code	pre-charge voltage																											
00000	00h	0.20 x V _{CC}																											
:	:	:																											
11111	1Fh	0.60 x V _{CC}																											
0	BE	1	0	1	1	1	1	1	0	Set V _{COMH} Voltage	Set COM deselect voltage level [reset = 05h]																		
1	A[2:0]	0	0	0	0	0	A ₂	A ₁	A ₀																				
											<table border="1"> <thead> <tr> <th>A[2:0]</th> <th>Hex code</th> <th>V_{COMH}</th> </tr> </thead> <tbody> <tr> <td>000</td> <td>00h</td> <td>0.72 x V_{CC}</td> </tr> <tr> <td>:</td> <td>:</td> <td>:</td> </tr> <tr> <td>101</td> <td>05h</td> <td>0.82 x V_{CC} [reset]</td> </tr> <tr> <td>:</td> <td>:</td> <td>:</td> </tr> <tr> <td>111</td> <td>07h</td> <td>0.86 x V_{CC}</td> </tr> </tbody> </table> <p>Note ⁽¹⁾This command is locked by Command FDh by default. To unlock it, please refer to Command FDh.</p>	A[2:0]	Hex code	V _{COMH}	000	00h	0.72 x V _{CC}	:	:	:	101	05h	0.82 x V _{CC} [reset]	:	:	:	111	07h	0.86 x V _{CC}
A[2:0]	Hex code	V _{COMH}																											
000	00h	0.72 x V _{CC}																											
:	:	:																											
101	05h	0.82 x V _{CC} [reset]																											
:	:	:																											
111	07h	0.86 x V _{CC}																											

Fundamental Command Table											
D/C#	Hex	D7	D6	D5	D4	D3	D2	D1	D0	Command	Description
0	C1	1	1	0	0	0	0	0	1	Set Contrast Current for Color A,B,C	A[7:0] Contrast Value Color A [reset=10001010b]
1	A[7:0]	A ₇	A ₆	A ₅	A ₄	A ₃	A ₂	A ₁	A ₀		B[7:0] Contrast Value Color B [reset=01010001b]
1	B[7:0]	B ₇	B ₆	B ₅	B ₄	B ₃	B ₂	B ₁	B ₀		C[7:0] Contrast Value Color C [reset=10001010b]
1	C[7:0]	C ₇	C ₆	C ₅	C ₄	C ₃	C ₂	C ₁	C ₀		
0	C7	1	1	0	0	0	1	1	1	Master Contrast Current Control	A[3:0] :
1	A[3:0]	*	*	*	*	A ₃	A ₂	A ₁	A ₀		0000b reduce output currents for all colors to 1/16 0001b reduce output currents for all colors to 2/16 1110b reduce output currents for all colors to 15/16 1111b no change [reset]
0	CA	1	1	0	0	1	0	1	0	Set MUX Ratio	A[6:0] MUX ratio 16MUX ~ 128MUX, [reset=127], (Range from 15 to 127)
1	A[6:0]	0	A ₆	A ₅	A ₄	A ₃	A ₂	A ₁	A ₀		
0	D1	1	0	1	0	1	1	0	1	NOP	Command for No Operation
0	E3	1	1	1	0	0	0	1	1	NOP	Command for No Operation
0	FD	1	1	1	1	1	1	0	1	Set Command Lock	A[7:0]: MCU protection status [reset = 12h] A[7:0] = 12b, Unlock OLED driver IC MCU interface from entering command [reset] A[7:0] = 16b, Lock OLED driver IC MCU interface from entering command
1	A[7:0]	A ₇	A ₆	A ₅	A ₄	A ₃	A ₂	A ₁	A ₀		A[7:0] = B0b, Command A2,B1,B3,BB,BE,C1 inaccessible in both lock and unlock state [reset] A[7:0] = B1b, Command A2,B1,B3,BB,BE,C1 accessible if in unlock state
											Note (1) The locked OLED driver IC MCU interface prohibits all commands and memory access except the FDh command.

Note

(1) "*" stands for "Don't care".

Set (GAC) (D/C# = 0, R/W#(WR#)= 0, E(RD#) = 1) unless specific setting is stated

Single byte command (D/C# = 0), Multiple byte command (D/C# = 0 for first byte, D/C# = 1 for other bytes)

Graphic acceleration command										Command	Description
D/C#	Hex	D7	D6	D5	D4	D3	D2	D2	D0		
0	96	1	0	0	1	0	1	1	0		A[7:0] = 00000000b No scrolling
1	A[7:0]	A ₇	A ₆	A ₅	A ₄	A ₃	A ₂	A ₁	A ₀		A[7:0] = 00000001b to 00111111b Scroll towards SEG127 with 1 column offset
1	B[6:0]	0	B ₆	B ₅	B ₄	B ₃	B ₂	B ₁	B ₀		A[7:0] = 01000000b to 11111111b Scroll towards SEG0 with 1 column offset
1	C[7:0]	C ₇	C ₆	C ₅	C ₄	C ₃	C ₂	C ₁	C ₀		
1	D[6:0]	0	D ₆	D ₅	D ₄	D ₃	D ₂	D ₁	D ₀		B[6:0] : start row address
1	E[1:0]	0	0	0	0	0	0	E ₁	E ₀		C[7:0] : number of rows to be H-scrolled B+C ≤ 128
										Horizontal Scroll	D[6:0] : Reserved (reset=00h)
											E[1:0] : scrolling time interval 00b test mode 01b normal 10b slow 11b slowest
											Note (1) Operates during display ON.
0	9E	1	0	0	1	1	1	1	0	Stop Moving	Stop horizontal scroll
											Note (1) After sending 9Eh command to stop the scrolling action, the ram data needs to be rewritten
0	9F	1	0	0	1	1	1	1	1	Start Moving	Start horizontal scroll

Note

(1) After executed the graphic command, waiting time is required for update GDDRAM content.

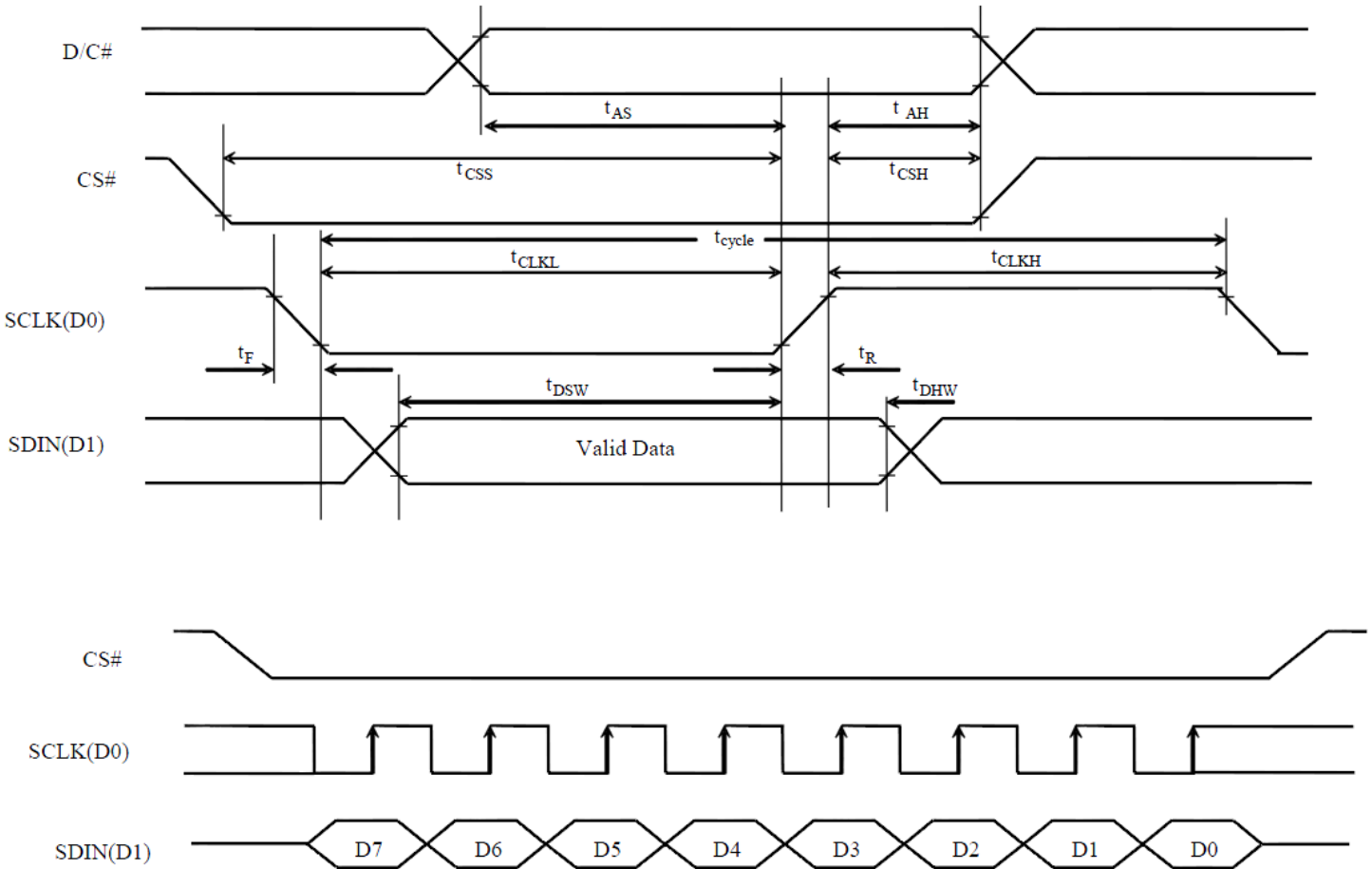
V_{CI} = 2.4~3.5V, waiting time = 500ns/pixel.

(2) “*” stands for “Don’t care”.

Timing Characteristics

4-wire SPI:

Symbol	Parameter	Min	Typ	Max	Unit
t_{cycle}	Clock Cycle Time	220	-	-	ns
t_{AS}	Address Setup Time	15	-	-	ns
t_{AH}	Address Hold Time	42	-	-	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	20	-	-	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



Example Initialization Sequence

```
void OLED_Init_12896RGB(void)
{
int i,j;
GPIO_ResetBits(GPIOC, RES);
graphic_delay(500000);
GPIO_SetBits(GPIOC, RES);
graphic_delay(500000);

oled_Command_12896RGB(0xFD); //Command lock setting
oled_Data_12896RGB(0x12); //unlock
oled_Command_12896RGB(0xFD); //Command lock setting
oled_Data_12896RGB(0xB1); //unlock

oled_Command_12896RGB(0xAE);

oled_Command_12896RGB(0xB3); //clock & frequency
oled_Data_12896RGB(0xF1); //clock=Diviser+1 frequency=fh

oled_Command_12896RGB(0xCA); //Duty
oled_Data_12896RGB(0x7F); //OLED_END+1

oled_Command_12896RGB(0xA2); //Display offset
oled_Data_12896RGB(0x00);

oled_Command_12896RGB(0xA1); //Set display start line
oled_Data_12896RGB(0x00); //0x00 start line

oled_Command_12896RGB(0xA0); //Set Re-map, color depth
oled_Data_12896RGB(0xA0); //8-bit 262K

oled_Command_12896RGB(0xB5); //set GPIO
oled_Data_12896RGB(0x00); //disabled

oled_Command_12896RGB(0xAB); //Function Set
oled_Data_12896RGB(0x01); //8-bit interface, internal VDD regulator

oled_Command_12896RGB(0xB4); //set VSL
oled_Data_12896RGB(0xA0); //external VSL
oled_Data_12896RGB(0xB5);
oled_Data_12896RGB(0x55);

oled_Command_12896RGB(0xC1); //Set contrast current for A,B,C
oled_Data_12896RGB(0x8a); //Color A //8a
oled_Data_12896RGB(0x51); //Color B //51
oled_Data_12896RGB(0x8a); //Color C //8a

oled_Command_12896RGB(0xC7); //Set master contrast
oled_Data_12896RGB(0x0F); //
```



```

oled_Command_12896RGB(0xB9);    //use linear grayscale LUT

oled_Command_12896RGB(0xB1);    //Set pre & dis-charge
oled_Data_12896RGB(0x32);      //pre=1h, dis=1h

oled_Command_12896RGB(0xBB);    //Set precharge voltage of color A,B,C
oled_Data_12896RGB(0x07);      //

oled_Command_12896RGB(0xB2);    //display enhancement
oled_Data_12896RGB(0xa4);
oled_Data_12896RGB(0x00);
oled_Data_12896RGB(0x00);

oled_Command_12896RGB(0xB6);    //precharge period
oled_Data_12896RGB(0x01);

oled_Command_12896RGB(0xBE);    //Set VcomH
oled_Data_12896RGB(0x07);

oled_Command_12896RGB(0xA6);    //Normal display

oled_Command_12896RGB(0x15);    //set column start and end addresses
oled_Data_12896RGB(0x00);    //
oled_Data_12896RGB(0x7F);    //
oled_Command_12896RGB(0x75);    //set row start and end addresses
oled_Data_12896RGB(0x00);    //
oled_Data_12896RGB(0x5F);    //
oled_Command_12896RGB(0x5C);    //write to RAM command

    for(i=0;i<128;i++)
    {
        for(j=0;j<96;j++)
        {
            oled_Data_12896RGB(0x00);
            oled_Data_12896RGB(0x00);
            oled_Data_12896RGB(0x00);
        }
    }
oled_Command_12896RGB(0xAF);    //Display on
}

int oled_12896RGB(void)
{
column = 0x00;
byte1 = 0x00;
byte2 = 0x00;
oled_Command_12896RGB(0x15);    //set column start and end addresses
oled_Data_12896RGB(column);    //
oled_Data_12896RGB(0x7F);    //

```

```

oled_Command_12896RGB(0x75);    //set row start and end addresses
oled_Data_12896RGB(0x00);      //
oled_Data_12896RGB(0x5F);      //
oled_Command_12896RGB(0x5C);    //write to RAM command

for (i=0;i<12288;i++)    //for each 24-bit pixel...128*96=12288
{
    f_read(&File1, &red, 1, &blen);    //read the red 8-bits
    f_read(&File1, &green, 1, &blen);    //read the green 8-bits
    f_read(&File1, &blue, 1, &blen);    //read the blue 8-bits

    red = red >> 2;
    green = green >> 2;
    blue = blue >> 2;
    oled_Data_12896RGB(red);
    oled_Data_12896RGB(green);
    oled_Data_12896RGB(blue);

}
////////////////////////////////////

```

Example Arduino Code

Please see: https://github.com/NewhavenDisplay/NHD-1.27-12896ASC3_Example

Quality Information

Test Item	Content of Test	Test Condition	Note
High Temperature storage	Test the endurance of the display at high storage temperature.	+80°C , 96hrs	2
Low Temperature storage	Test the endurance of the display at low storage temperature.	-40°C , 96hrs	1,2
High Temperature Operation	Test the endurance of the display by applying electric stress (voltage & current) at high temperature.	+70°C 96hrs	2
Low Temperature Operation	Test the endurance of the display by applying electric stress (voltage & current) at low temperature.	-30°C , 96hrs	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 , 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.	-30°C,30min -> 25°C,5min -> 70°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

NHD-1.5-AU-SHIELD

Graphic Color OLED Display Module + Arduino UNO Shield

NHD-	Newhaven Display
1.5-	1.5" Diagonal Size
AU-	Arduino Uno
SHIELD-	Shield

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

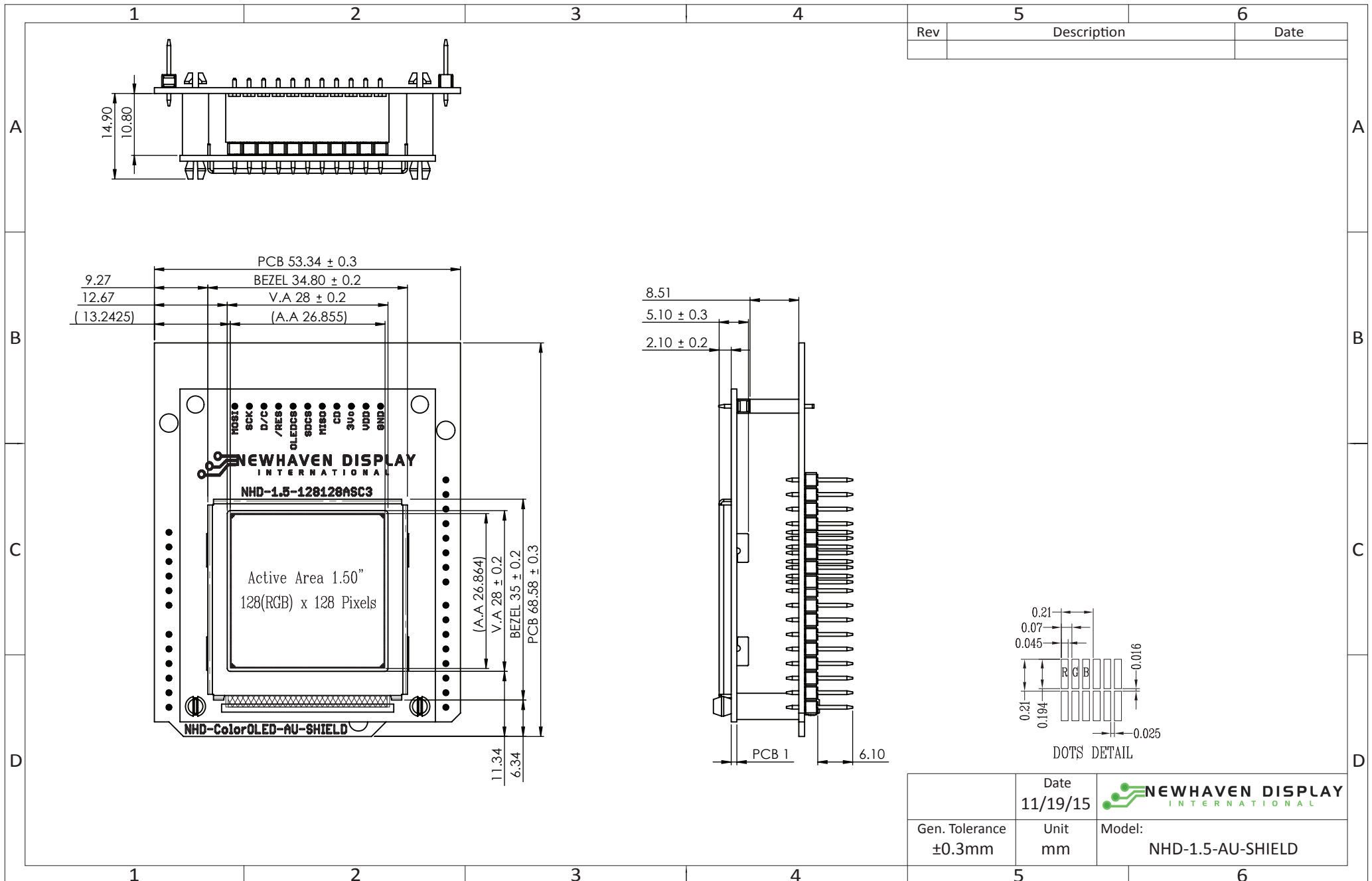
Document Revision History

Revision	Date	Description	Changed by
0	11/19/2015	Initial Release	PB
1	1/11/2016	Functions and Features Updated	PB


Functions and Features

- 128 x 128 pixel resolution
- Built-in SSD1351 controller
- SPI MPU interface
- RoHS compliant
- microSD card reader (microSD card not included)
- Built-in logic level shifting for 3.3V ~ 5V operation

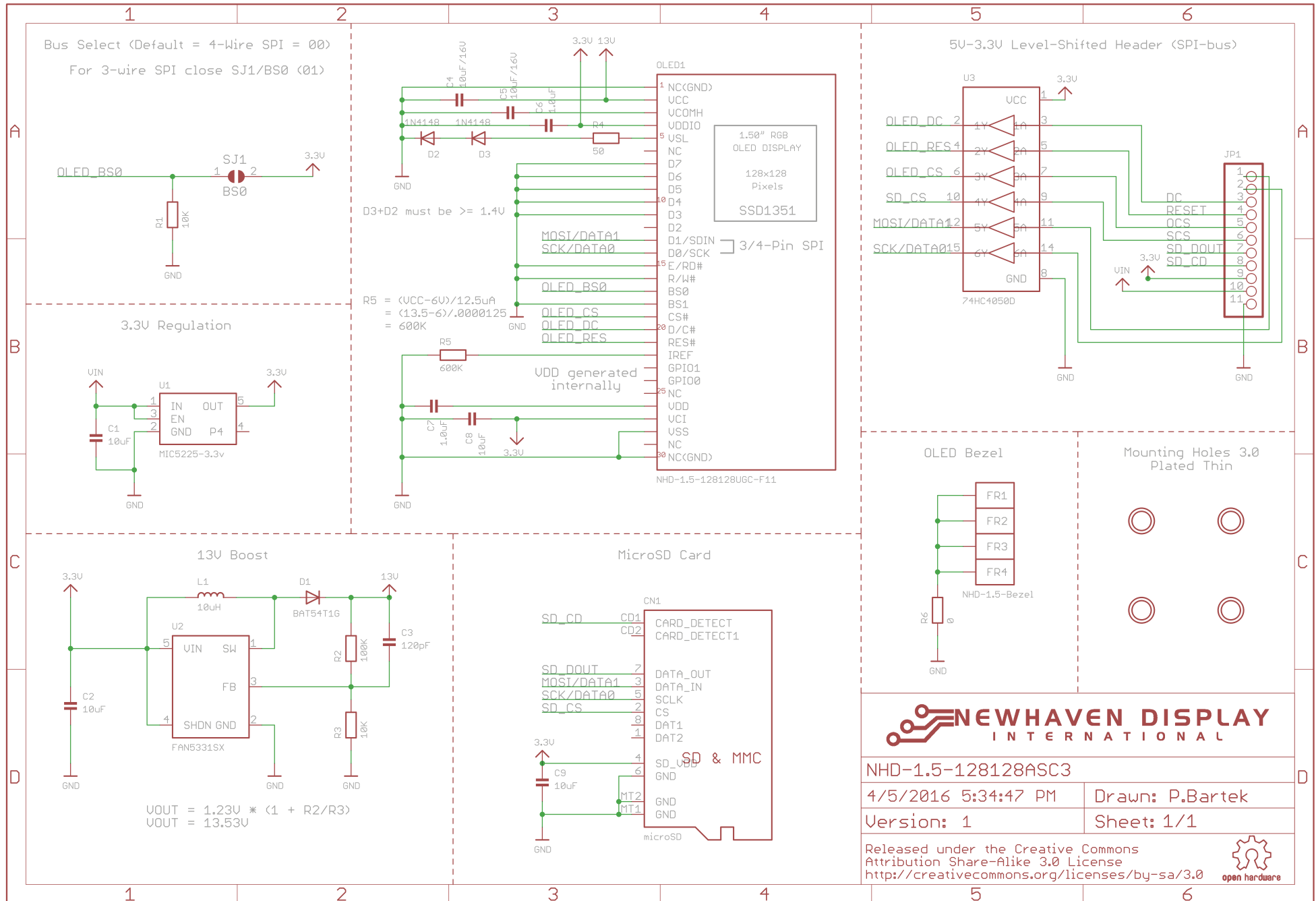
Mechanical Drawing

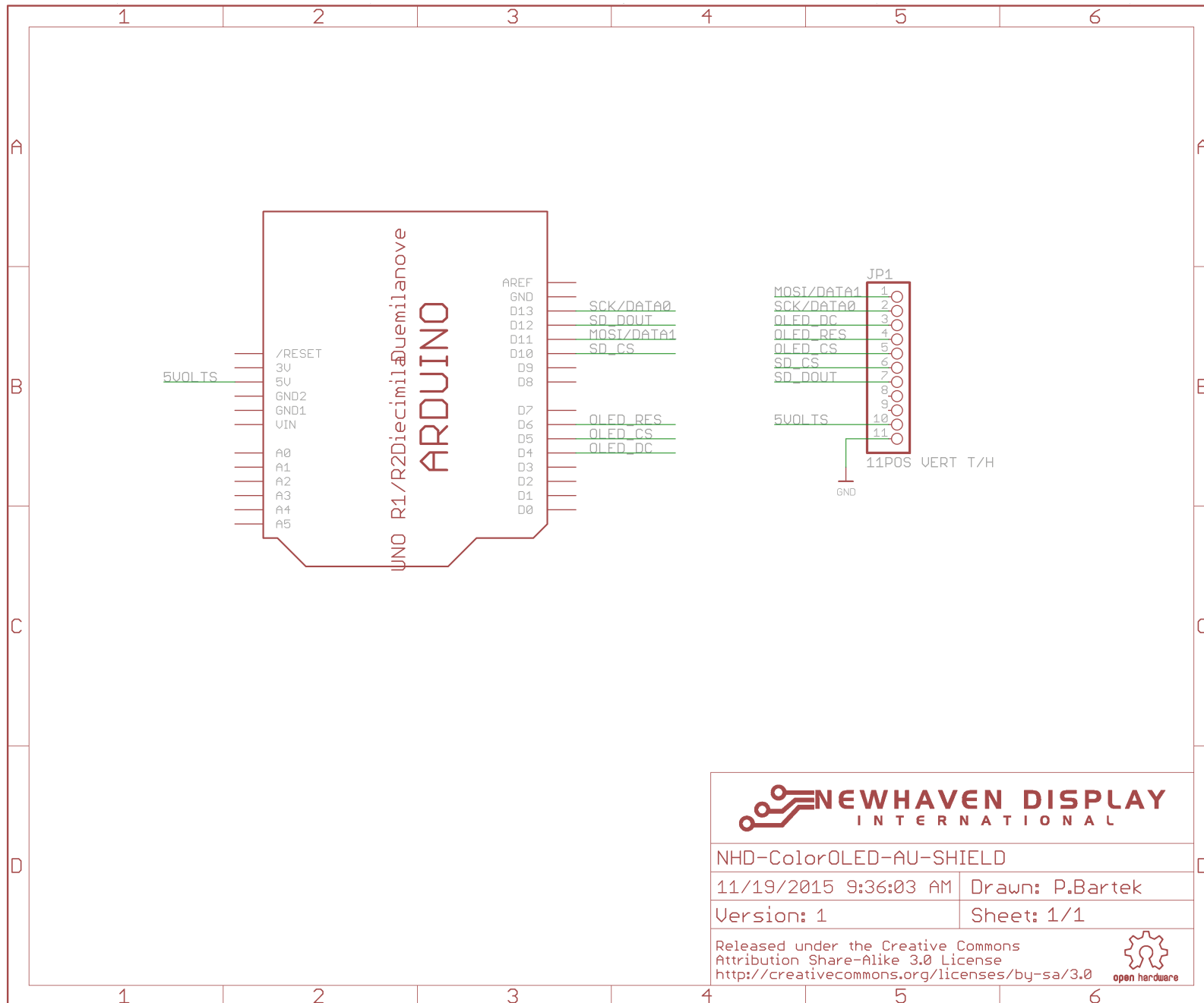


Rev	Description	Date

	Date 11/19/15	 NEWHAVEN DISPLAY INTERNATIONAL
Gen. Tolerance ±0.3mm	Unit mm	

Schematic






NEWHAVEN DISPLAY
INTERNATIONAL

NHD-ColorOLED-AU-SHIELD

11/19/2015 9:36:03 AM | Drawn: P.Bartek

Version: 1 | Sheet: 1/1

Released under the Creative Commons Attribution Share-Alike 3.0 License
<http://creativecommons.org/licenses/by-sa/3.0>



Interface Description

JP1 Interface:

Pin No.	Symbol	External Connection	Function Description
1	MOSI	MPU	Master Out Slave In
2	SCK	MPU	Serial Clock signal
3	D/C	MPU	Register Select signal. D/C=0: Command, D/C=1: Data
4	/RES	MPU	Active LOW Reset signal
5	OLEDCS	MPU	OLED Active LOW Chip Select signal
6	SDCS	MPU	Micro SD Active LOW Chip Select signal
7	MISO	MPU	Master In / Slave Out
8	NC	-	No Connect
9	NC	-	No Connect
10	VDD	Power Supply	Supply Voltage for OLED and logic (3.3V~5V)
11	GND	Power Supply	Ground

JP2 Interface:

Shield Pin Symbol	Arduino UNO Pin Symbol	Function Description
AREF	AREF	No Connect
GND	GND	Ground
Digital 13	13	Serial Clock signal
Digital 12	12	Master In / Slave Out
Digital 11	11	Master Out Slave In
Digital 10	10	Micro SD Active LOW Chip Select signal
Digital 9	9	No Connect
Digital 8	8	No Connect

JP3 Interface:

Shield Pin Symbol	Arduino UNO Pin Symbol	Function Description
Digital 7	7	No Connect
Digital 6	6	Active LOW Reset signal
Digital 5	5	OLED Active LOW Chip Select signal
Digital 4	4	Register Select signal. D/C=0: Command, D/C=1: Data
Digital 3	3	No Connect
Digital 2	2	No Connect
Digital 1	1	No Connect
Digital 0	0	No Connect

JP4 Interface:

Shield Pin Symbol	Arduino UNO Pin Symbol	Function Description
Analog 5	A5	No Connect
Analog 4	A4	No Connect
Analog 3	A3	No Connect
Analog 2	A2	No Connect
Analog 1	A1	No Connect
Analog 0	A0	No Connect

JP5 Interface:

Shield Pin Symbol	Arduino UNO Pin Symbol	Function Description
RST	RESET	No Connect
3V	3.3V	No Connect
5V	5V	Supply Voltage for OLED and logic (5V)
GND	GND	No Connect
GND	GND	No Connect
Vin	Vin	No Connect

Electrical Characteristics

Item	Symbol	Condition	Min.	Typ.	Max.	Unit
Operating Temperature Range	Top	Absolute Max	-30	-	+70	°C
Storage Temperature Range	Tst	Absolute Max	-40	-	+80	°C
Supply Voltage	VDD		3.0	3.3	5.5	V
Supply Current	IDD		-	85	200	mA
"H" Level input	Vih		0.8*VDD	-	VDD	V
"L" Level input	Vil		0	-	0.2*VDD	V
"H" Level output	Voh		0.9*VDD	-	VDD	V
"L" Level output	Vol		0	-	0.1*VDD	V

Optical Characteristics

Item	Symbol	Condition	Min.	Typ.	Max.	Unit
Viewing Angle – Top			80	-	-	°
Viewing Angle – Bottom			80	-	-	°
Viewing Angle – Left			80	-	-	°
Viewing Angle – Right			80	-	-	°
Contrast Ratio	Cr		-	2000:1	-	-
Response Time (rise)	Tr	-	-	10	-	us
Response Time (fall)	Tf	-	-	10	-	us
Brightness		50% checkerboard	70	90	-	cd/m ²
Lifetime		90 cd/m ² , Ta=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 SSD1351 controller.

Please download specification at www.newhavendisplay.com/app_notes/SSD1351.pdf

Table of Commands

(D/C# = 0, R/W#(WR#)= 0, E(RD#) = 1) unless specific setting is stated

Single byte command (D/C# = 0), Multiple byte command (D/C# = 0 for first byte, D/C# = 1 for other bytes)

Fundamental Command Table											
D/C#	Hex	D7	D6	D5	D4	D3	D2	D1	D0	Command	Description
0	15	0	0	0	1	0	1	0	1	Set Column Address	A[6:0]: Start Address. [reset=0] B[6:0]: End Address. [reset=127] Range from 0 to 127
1	A[6:0]	*	A ₆	A ₅	A ₄	A ₃	A ₂	A ₁	A ₀		
1	B[6:0]	*	B ₆	B ₅	B ₄	B ₃	B ₂	B ₁	B ₀		
0	75	0	1	1	1	0	1	0	1	Set Row Address	A[6:0]: Start Address. [reset=0] B[6:0]: End Address. [reset=127] Range from 0 to 127
1	A[6:0]	*	A ₆	A ₅	A ₄	A ₃	A ₂	A ₁	A ₀		
1	B[6:0]	*	B ₆	B ₅	B ₄	B ₃	B ₂	B ₁	B ₀		
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	A0	1	0	1	0	0	0	0	0	Set Re-map / Color Depth (Display RAM to Panel)	A[0]=0b, Horizontal address increment [reset] A[0]=1b, Vertical address increment
1	A[7:0]	A ₇	A ₆	A ₅	A ₄	A ₃	A ₂	A ₁	A ₀		<p>A[1]=0b, Column address 0 is mapped to SEG0 [reset] A[1]=1b, Column address 127 is mapped to SEG0</p> <p>A[2]=0b, Color sequence: A → B → C [reset] A[2]=1b, Color sequence is swapped: C → B → A</p> <p>A[3]=0b, Reserved A[3]=1b, Reserved</p> <p>A[4]=0b, Scan from COM0 to COM[N-1] [reset] A[4]=1b, Scan from COM[N-1] to COM0. Where N is the Multiplex ratio.</p> <p>A[5]=0b, Disable COM Split Odd Even A[5]=1b, Enable COM Split Odd Even [reset]</p> <p>A[7:6] Set Color Depth, 00b / 01b: 65k color [reset] 10b: 262k color 11b 262k color, 16-bit format 2</p> <p>Refer to Table 8-8 for details</p>

Fundamental Command Table											
D/C#	Hex	D7	D6	D5	D4	D3	D2	D1	D0	Command	Description
0 1	A1 A[6:0]	1 *	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 vertical scroll by RAM from 0~127. [reset=00h]
0 1	A2 A[6:0]	1 *	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 scroll by Row from 0-127. [reset=60h] Note (1) This command is locked by Command FDh by default. To unlock it, please refer to Command FDh.
0	A4~A7	1	0	1	0	0	1	X ₁	X ₀	Set Display Mode	A4h: All OFF A5h: All ON (All pixels have GS63) A6h : Reset to normal display [reset] A7h: Inverse Display (GS0 -> GS63, GS1 -> GS62,)
0 1	AB A[7:0]	1 A ₇	0 A ₆	1 0	0 0	1 0	0 0	1 0	1 A ₀	Function Selection	A[0]=0b, Select external V _{DD} A[0]=1b, Enable internal V _{DD} regulator [reset] A[7:6]=00b, Select 8-bit parallel interface [reset] A[7:6]=01b, Select 16-bit parallel interface A[7:6]=11b, Select 18-bit parallel interface
0	AD	1	0	1	0	1	1	0	1	NOP	Command for no operation.
0	AE~AF	1	0	1	0	1	1	1	X ₀	Set Sleep mode ON/OFF	AEh = Sleep mode On (Display OFF) AFh = Sleep mode OFF (Display ON)
0	B0	1	0	1	1	0	0	0	0	NOP	Command for no operation.
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	Set Reset (Phase 1) / Pre-charge (Phase 2) period	A[3:0] Phase 1 period of 5~31 DCLK(s) clocks [reset=0010b] A[3:0]: 0-1 invalid 2 = 5 DCLKs 3 = 7 DCLKs : 15 = 31DCLKs A[7:4] Phase 2 period of 3~15 DCLK(s) clocks [reset=1000b] A[7:4]: 0-2 invalid 3 = 3 DCLKs 4 = 4 DCLKs : 15 = 15DCLKs Note (1) 0 DCLK is invalid in phase 1 & phase 2 (2) This command is locked by Command FDh by default. To unlock it, please refer to Command FDh.

Fundamental Command Table																																					
D/C#	Hex	D7	D6	D5	D4	D3	D2	D1	D0	Command	Description																										
0	B2	1	0	1	1	0	0	1	0	Display Enhancement	A[7:0] = 00h, B[7:0] = 00h, C[7:0] = 00h normal [reset] A[7:0] = A4h, B[7:0] = 00h, C[7:0] = 00h enhance display performance																										
1	A[7:0]	A ₇	A ₆	A ₅	A ₄	A ₃	A ₂	A ₁	A ₀																												
1	B[7:0]	0	0	0	0	0	0	0	0																												
1	C[7:0]	0	0	0	0	0	0	0	0																												
0	B3	1	0	1	1	0	0	1	1	Front Clock Divider (DivSet)/ Oscillator Frequency	A[3:0] [reset=0001], divide by DIVSET where <table border="1" style="margin-left: auto; margin-right: auto;"> <thead> <tr> <th>A[3:0]</th> <th>DIVSET</th> </tr> </thead> <tbody> <tr><td>0000</td><td>divide by 1</td></tr> <tr><td>0001</td><td>divide by 2</td></tr> <tr><td>0010</td><td>divide by 4</td></tr> <tr><td>0011</td><td>divide by 8</td></tr> <tr><td>0100</td><td>divide by 16</td></tr> <tr><td>0101</td><td>divide by 32</td></tr> <tr><td>0110</td><td>divide by 64</td></tr> <tr><td>0111</td><td>divide by 128</td></tr> <tr><td>1000</td><td>divide by 256</td></tr> <tr><td>1001</td><td>divide by 512</td></tr> <tr><td>1010</td><td>divide by 1024</td></tr> <tr><td>>=1011</td><td>invalid</td></tr> </tbody> </table> A[7:4] Oscillator frequency, frequency increases as level increases [reset=1101b] Note ⁽¹⁾ This command is locked by Command FDh by default. To unlock it, please refer to Command FDh.	A[3:0]	DIVSET	0000	divide by 1	0001	divide by 2	0010	divide by 4	0011	divide by 8	0100	divide by 16	0101	divide by 32	0110	divide by 64	0111	divide by 128	1000	divide by 256	1001	divide by 512	1010	divide by 1024	>=1011	invalid
A[3:0]	DIVSET																																				
0000	divide by 1																																				
0001	divide by 2																																				
0010	divide by 4																																				
0011	divide by 8																																				
0100	divide by 16																																				
0101	divide by 32																																				
0110	divide by 64																																				
0111	divide by 128																																				
1000	divide by 256																																				
1001	divide by 512																																				
1010	divide by 1024																																				
>=1011	invalid																																				
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 Segment Low Voltage (VSL)	A[1:0]=00 External VSL [reset] A[1:0]=01,10,11 are invalid Note ⁽¹⁾ When external VSL is enabled, in order to avoid distortion in display pattern, an external circuit is needed to connect between VSL and V _{SS} as shown in Figure 14-1.																										
1	A[7:0]	1	0	1	0	0	0	A ₁	A ₀																												
1	B[7:0]	1	0	1	1	0	1	0	1																												
1	C[7:0]	0	1	0	1	0	1	0	1																												
0	B5	1	0	1	1	0	1	0	1	Set GPIO	A[1:0] GPIO0: 00 pin HiZ, Input disabled 01 pin HiZ, Input enabled 10 pin output LOW [reset] 11 pin output HIGH A[3:2] GPIO1: 00 pin HiZ, Input disabled 01 pin HiZ, Input enabled 10 pin output LOW [reset] 11 pin output HIGH																										
1	A[3:0]	*	*	*	*	A ₃	A ₂	A ₁	A ₀																												
0	B6	1	0	1	1	0	1	0	0	Set Second Pre-charge Period	A[3:0] Set Second Pre-charge Period 0000b invalid 0001b 1 DCLKS 0010b 2 DCLKS 1000 8 DCLKS [reset] 1111 15 DCLKS																										
1	A[3:0]	*	*	*	*	A ₃	A ₂	A ₁	A ₀																												

Fundamental Command Table																													
D/C#	Hex	D7	D6	D5	D4	D3	D2	D1	D0	Command	Description																		
0	B8	1	0	1	1	1	0	0	0	Look Up Table for Gray Scale Pulse width	The next 63 data bytes define Gray Scale (GS) Table by setting the gray scale pulse width in unit of DCLK's (ranges from 0d ~ 180d) A1[7:0]: Gamma Setting for GS1, A2[7:0]: Gamma Setting for GS2, : A62[7:0]: Gamma Setting for GS62, A63[7:0]: Gamma Setting for GS63 Note ⁽¹⁾ 0 ≤ Setting of GS1 < Setting of GS2 < Setting of GS3..... < Setting of GS62 < Setting of GS63 ⁽²⁾ GS0 has only pre-charge but no current drive stages. ⁽³⁾ GS1 can be set as only pre-charge but no current drive stage by input gamma setting for GS1 equals 0.																		
1	A1[7:0]	A1 ₇	A1 ₆	A1 ₅	A1 ₄	A1 ₃	A1 ₂	A1 ₁	A1 ₀																				
1	A2[7:0]	A2 ₇	A2 ₆	A2 ₅	A2 ₄	A2 ₃	A2 ₂	A2 ₁	A2 ₀																				
1																				
1																				
1																				
1	A62[7:0]	A62 ₇	A62 ₆	A62 ₅	A62 ₄	A62 ₃	A62 ₂	A62 ₁	A62 ₀																				
1	A63[7:0]	A63 ₇	A63 ₆	A63 ₅	A63 ₄	A63 ₃	A63 ₂	A63 ₁	A63 ₀																				
0	B9	1	0	1	1	1	0	0	1	Use Built-in Linear LUT [reset= linear]	Reset to default Look Up Table: GS1 = 0 DCLK GS2 = 2 DCLK GS3 = 4 DCLK GS4 = 6 DCLK ... GS62 = 122 DCLK GS63 = 124 DCLK																		
0	BB	1	0	1	1	1	0	1	1	Set Pre-charge voltage	Set pre-charge voltage level.[reset = 17h] <table border="1"> <thead> <tr> <th>A[4:0]</th> <th>Hex code</th> <th>pre-charge voltage</th> </tr> </thead> <tbody> <tr> <td>00000</td> <td>00h</td> <td>0.20 x V_{CC}</td> </tr> <tr> <td>:</td> <td>:</td> <td>:</td> </tr> <tr> <td>11111</td> <td>1Fh</td> <td>0.60 x V_{CC}</td> </tr> </tbody> </table> Note ⁽¹⁾ This command is locked by Command FDh by default. To unlock it, please refer to Command FDh.	A[4:0]	Hex code	pre-charge voltage	00000	00h	0.20 x V _{CC}	:	:	:	11111	1Fh	0.60 x V _{CC}						
A[4:0]	Hex code	pre-charge voltage																											
00000	00h	0.20 x V _{CC}																											
:	:	:																											
11111	1Fh	0.60 x V _{CC}																											
1	A[4:0]	0	0	0	A ₄	A ₃	A ₂	A ₁	A ₀																				
0	BE	1	0	1	1	1	1	1	0	Set V _{COMH} Voltage	Set COM deselect voltage level [reset = 05h] <table border="1"> <thead> <tr> <th>A[2:0]</th> <th>Hex code</th> <th>V_{COMH}</th> </tr> </thead> <tbody> <tr> <td>000</td> <td>00h</td> <td>0.72 x V_{CC}</td> </tr> <tr> <td>:</td> <td>:</td> <td>:</td> </tr> <tr> <td>101</td> <td>05h</td> <td>0.82 x V_{CC} [reset]</td> </tr> <tr> <td>:</td> <td>:</td> <td>:</td> </tr> <tr> <td>111</td> <td>07h</td> <td>0.86 x V_{CC}</td> </tr> </tbody> </table> Note ⁽¹⁾ This command is locked by Command FDh by default. To unlock it, please refer to Command FDh.	A[2:0]	Hex code	V _{COMH}	000	00h	0.72 x V _{CC}	:	:	:	101	05h	0.82 x V _{CC} [reset]	:	:	:	111	07h	0.86 x V _{CC}
A[2:0]	Hex code	V _{COMH}																											
000	00h	0.72 x V _{CC}																											
:	:	:																											
101	05h	0.82 x V _{CC} [reset]																											
:	:	:																											
111	07h	0.86 x V _{CC}																											
1	A[2:0]	0	0	0	0	0	A ₂	A ₁	A ₀																				

Fundamental Command Table											
D/C#	Hex	D7	D6	D5	D4	D3	D2	D1	D0	Command	Description
0	C1	1	1	0	0	0	0	0	1	Set Contrast Current for Color A,B,C	A[7:0] Contrast Value Color A [reset=10001010b]
1	A[7:0]	A ₇	A ₆	A ₅	A ₄	A ₃	A ₂	A ₁	A ₀		B[7:0] Contrast Value Color B [reset=01010001b]
1	B[7:0]	B ₇	B ₆	B ₅	B ₄	B ₃	B ₂	B ₁	B ₀		C[7:0] Contrast Value Color C [reset=10001010b]
1	C[7:0]	C ₇	C ₆	C ₅	C ₄	C ₃	C ₂	C ₁	C ₀		
0	C7	1	1	0	0	0	1	1	1	Master Contrast Current Control	A[3:0] :
1	A[3:0]	*	*	*	*	A ₃	A ₂	A ₁	A ₀		0000b reduce output currents for all colors to 1/16 0001b reduce output currents for all colors to 2/16 1110b reduce output currents for all colors to 15/16 1111b no change [reset]
0	CA	1	1	0	0	1	0	1	0	Set MUX Ratio	A[6:0] MUX ratio 16MUX ~ 128MUX, [reset=127], (Range from 15 to 127)
1	A[6:0]	0	A ₆	A ₅	A ₄	A ₃	A ₂	A ₁	A ₀		
0	D1	1	0	1	0	1	1	0	1	NOP	Command for No Operation
0	E3	1	1	1	0	0	0	1	1	NOP	Command for No Operation
0	FD	1	1	1	1	1	1	0	1	Set Command Lock	A[7:0]: MCU protection status [reset = 12h] A[7:0] = 12b, Unlock OLED driver IC MCU interface from entering command [reset] A[7:0] = 16b, Lock OLED driver IC MCU interface from entering command
1	A[7:0]	A ₇	A ₆	A ₅	A ₄	A ₃	A ₂	A ₁	A ₀		A[7:0] = B0b, Command A2,B1,B3,BB,BE,C1 inaccessible in both lock and unlock state [reset] A[7:0] = B1b, Command A2,B1,B3,BB,BE,C1 accessible if in unlock state
											Note (1) The locked OLED driver IC MCU interface prohibits all commands and memory access except the FDh command.

Note

(1) "*" stands for "Don't care".

Set (GAC) (D/C# = 0, R/W#(WR#)= 0, E(RD#) = 1) unless specific setting is stated

Single byte command (D/C# = 0), Multiple byte command (D/C# = 0 for first byte, D/C# = 1 for other bytes)

Graphic acceleration command										Command	Description
D/C#	Hex	D7	D6	D5	D4	D3	D2	D2	D0		
0	96	1	0	0	1	0	1	1	0		A[7:0] = 00000000b No scrolling
1	A[7:0]	A ₇	A ₆	A ₅	A ₄	A ₃	A ₂	A ₁	A ₀		A[7:0] = 00000001b to 00111111b Scroll towards SEG127 with 1 column offset
1	B[6:0]	0	B ₆	B ₅	B ₄	B ₃	B ₂	B ₁	B ₀		A[7:0] = 01000000b to 11111111b Scroll towards SEG0 with 1 column offset
1	C[7:0]	C ₇	C ₆	C ₅	C ₄	C ₃	C ₂	C ₁	C ₀		
1	D[6:0]	0	D ₆	D ₅	D ₄	D ₃	D ₂	D ₁	D ₀		B[6:0] : start row address
1	E[1:0]	0	0	0	0	0	0	E ₁	E ₀		C[7:0] : number of rows to be H-scrolled B+C ≤ 128
										Horizontal Scroll	D[6:0] : Reserved (reset=00h)
											E[1:0] : scrolling time interval 00b test mode 01b normal 10b slow 11b slowest
											Note (1) Operates during display ON.
0	9E	1	0	0	1	1	1	1	0	Stop Moving	Stop horizontal scroll
											Note (1) After sending 9Eh command to stop the scrolling action, the ram data needs to be rewritten
0	9F	1	0	0	1	1	1	1	1	Start Moving	Start horizontal scroll

Note

(1) After executed the graphic command, waiting time is required for update GDDRAM content.

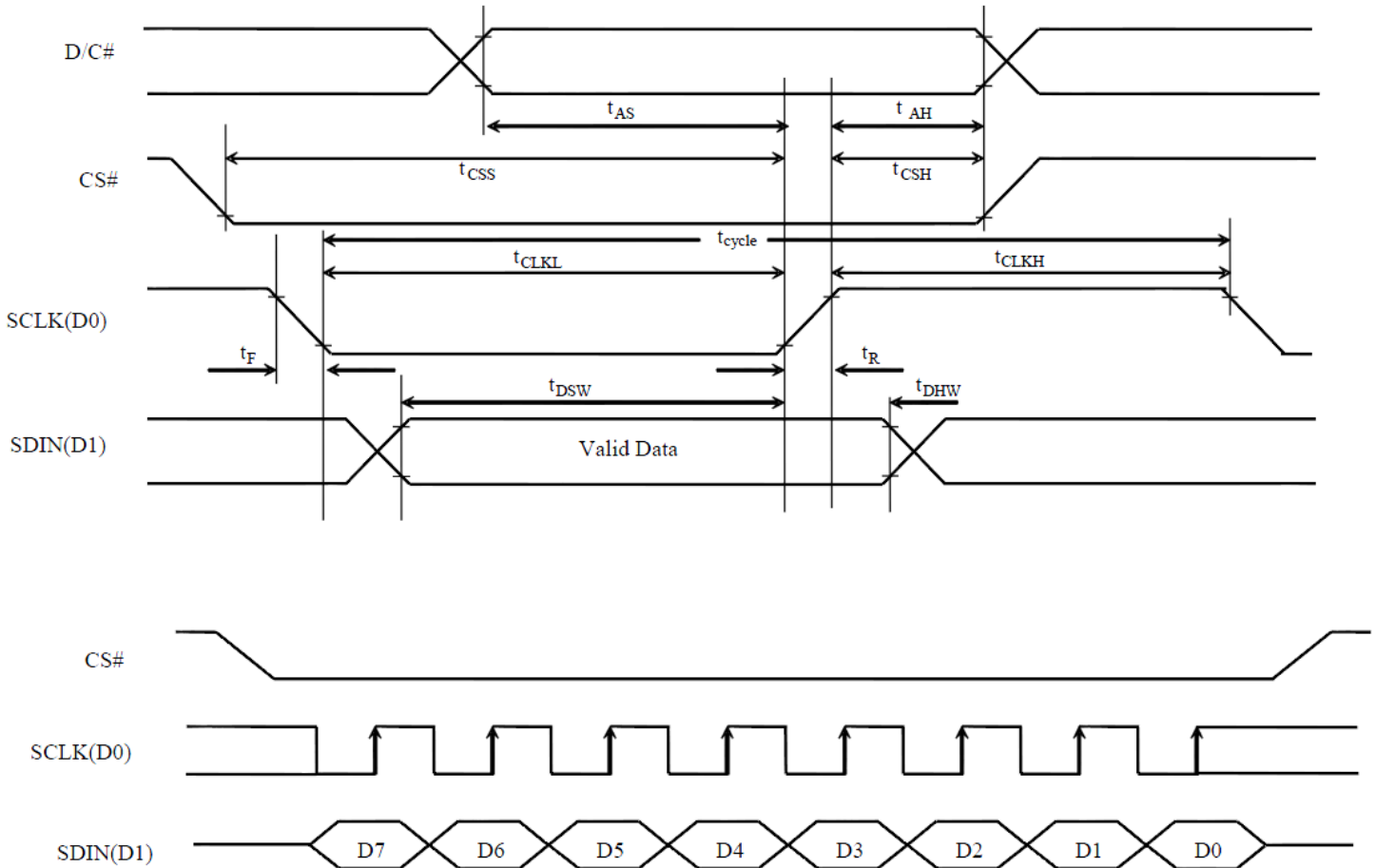
V_{CI} = 2.4~3.5V, waiting time = 500ns/pixel.

(2) “*” stands for “Don’t care”.

Timing Characteristics

4-wire SPI:

Symbol	Parameter	Min	Typ	Max	Unit
t_{cycle}	Clock Cycle Time	220	-	-	ns
t_{AS}	Address Setup Time	15	-	-	ns
t_{AH}	Address Hold Time	42	-	-	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	20	-	-	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



Example Initialization Sequence

```
void OLED_Init_128128RGB(void)
{
int i,j;
GPIO_ResetBits(GPIOC, RES);
graphic_delay(500000);
GPIO_SetBits(GPIOC, RES);
graphic_delay(500000);

oled_Command_128128RGB(0xFD); //Command lock setting
oled_Data_128128RGB(0x12); //unlock
oled_Command_128128RGB(0xFD); //Command lock setting
oled_Data_128128RGB(0xB1); //unlock

oled_Command_128128RGB(0xAE);

oled_Command_128128RGB(0xB3); //clock & frequency
oled_Data_128128RGB(0xF1); //clock=Diviser+1 frequency=fh

oled_Command_128128RGB(0xCA); //Duty
oled_Data_128128RGB(0x7F); //OLED_END+1

oled_Command_128128RGB(0xA2); //Display offset
oled_Data_128128RGB(0x00);

oled_Command_128128RGB(0xA1); //Set display start line
oled_Data_128128RGB(0x00); //0x00 start line

oled_Command_128128RGB(0xA0); //Set Re-map, color depth
oled_Data_128128RGB(0xA0); //8-bit 262K

oled_Command_128128RGB(0xB5); //set GPIO
oled_Data_128128RGB(0x00); //disabled

oled_Command_128128RGB(0xAB); //Function Set
oled_Data_128128RGB(0x01); //8-bit interface, internal VDD regulator

oled_Command_128128RGB(0xB4); //set VSL
oled_Data_128128RGB(0xA0); //external VSL
oled_Data_128128RGB(0xB5);
oled_Data_128128RGB(0x55);

oled_Command_128128RGB(0xC1); //Set contrast current for A,B,C
oled_Data_128128RGB(0x8a); //Color A //8a
oled_Data_128128RGB(0x51); //Color B //51
oled_Data_128128RGB(0x8a); //Color C //8a

oled_Command_128128RGB(0xC7); //Set master contrast
oled_Data_128128RGB(0x0F); //
```

```

oled_Command_128128RGB(0xB9); //use linear grayscale LUT

oled_Command_128128RGB(0xB1); //Set pre & dis-charge
oled_Data_128128RGB(0x32); //pre=1h, dis=1h

oled_Command_128128RGB(0xBB); //Set precharge voltage of color A,B,C
oled_Data_128128RGB(0x07); //

oled_Command_128128RGB(0xB2); //display enhancement
oled_Data_128128RGB(0xa4);
oled_Data_128128RGB(0x00);
oled_Data_128128RGB(0x00);

oled_Command_128128RGB(0xB6); //precharge period
oled_Data_128128RGB(0x01);

oled_Command_128128RGB(0xBE); //Set VcomH
oled_Data_128128RGB(0x07);

oled_Command_128128RGB(0xA6); //Normal display

oled_Command_128128RGB(0x15); //set column start and end addresses
oled_Data_128128RGB(0x00); //
oled_Data_128128RGB(0x7F); //
oled_Command_128128RGB(0x75); //set row start and end addresses
oled_Data_128128RGB(0x00); //
oled_Data_128128RGB(0x7F); //
oled_Command_128128RGB(0x5C); //write to RAM command

    for(i=0;i<128;i++)
    {
        for(j=0;j<128;j++)
        {
            oled_Data_128128RGB(0x00);
            oled_Data_128128RGB(0x00);
            oled_Data_128128RGB(0x00);
        }
    }
oled_Command_128128RGB(0xAF); //Display on
}

int oled_128128RGB(void)
{
column = 0x00;
byte1 = 0x00;
byte2 = 0x00;
oled_Command_128128RGB(0x15); //set column start and end addresses
oled_Data_128128RGB(column); //
oled_Data_128128RGB(0x7F); //

```

```

oled_Command_128128RGB(0x75); //set row start and end addresses
oled_Data_128128RGB(0x00); //
oled_Data_128128RGB(0x7F); //
oled_Command_128128RGB(0x5C); //write to RAM command

for (i=0;i<16384;i++) //for each 24-bit pixel...128*128=16384
{
    f_read(&File1, &red, 1, &blen); //read the red 8-bits
    f_read(&File1, &green, 1, &blen); //read the green 8-bits
    f_read(&File1, &blue, 1, &blen); //read the blue 8-bits

    red = red >> 2;
    green = green >> 2;
    blue = blue >> 2;
    oled_Data_128128RGB(red);
    oled_Data_128128RGB(green);
    oled_Data_128128RGB(blue);

}
////////////////////////////////////

```

Example Arduino Code

Please see: https://github.com/NewhavenDisplay/NHD-1.5-128128ASC3_Example

Quality Information

Test Item	Content of Test	Test Condition	Note
High Temperature storage	Test the endurance of the display at high storage temperature.	+80°C , 96hrs	2
Low Temperature storage	Test the endurance of the display at low storage temperature.	-40°C , 96hrs	1,2
High Temperature Operation	Test the endurance of the display by applying electric stress (voltage & current) at high temperature.	+70°C 96hrs	2
Low Temperature Operation	Test the endurance of the display by applying electric stress (voltage & current) at low temperature.	-30°C , 96hrs	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 , 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.	-30°C,30min -> 25°C,5min -> 70°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

NHD-1.69-AU-SHIELD

Graphic Color OLED Display Module + Arduino UNO Shield

NHD-	Newhaven Display
1.69-	1.69" Diagonal Size
AU-	Arduino Uno
SHIELD-	Shield

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

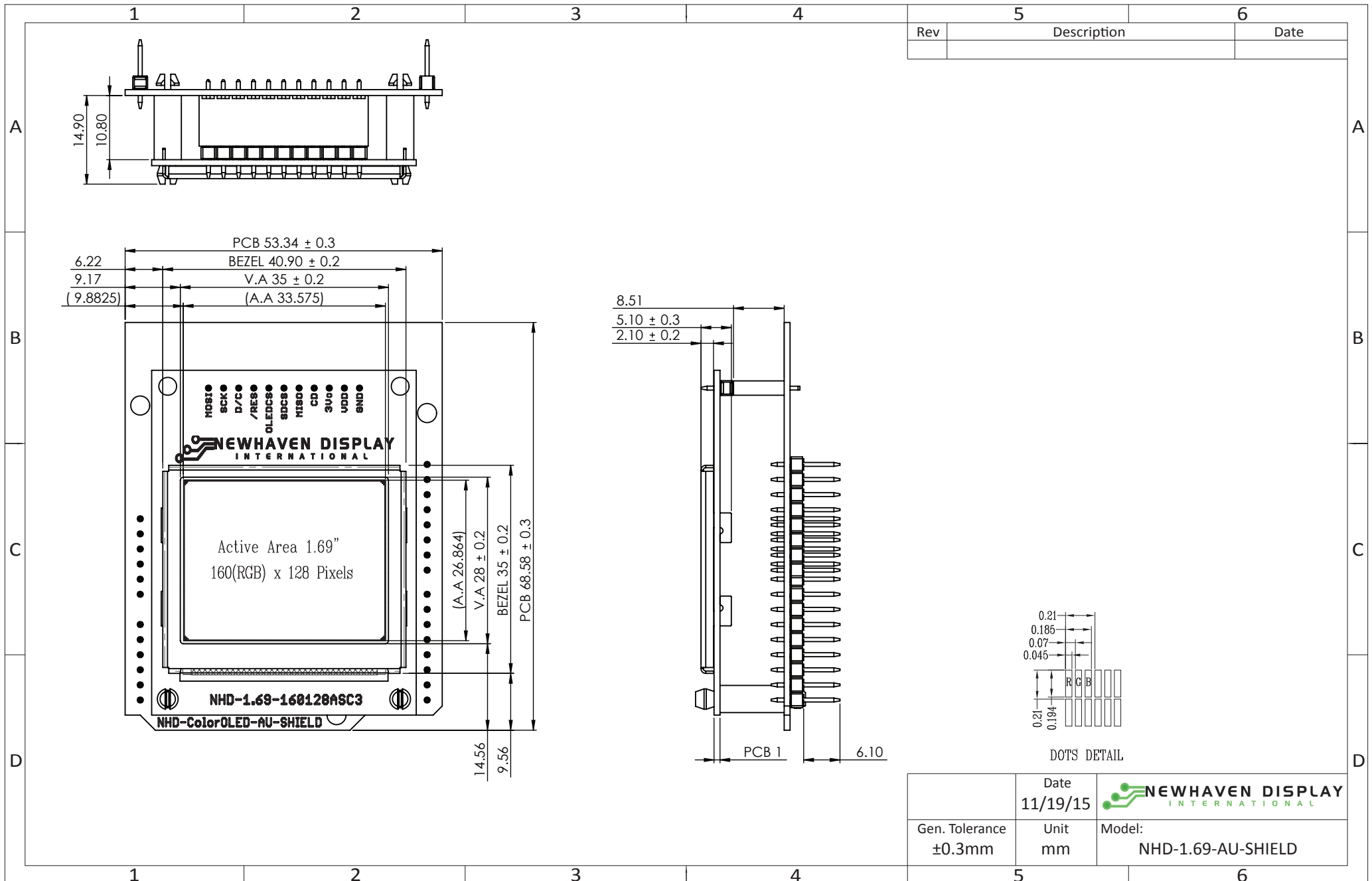
Document Revision History

Revision	Date	Description	Changed by
0	11/19/2015	Initial Release	PB
1	01/11/2016	Functions and Features Updated	PB
2	03/01/2016	Example Initialization Sequence & Schematic Typo Updated	PB

Functions and Features

- 160 x 128 pixel resolution
- Built-in SEPS525 controller
- SPI MPU interface
- RoHS compliant
- microSD card reader (microSD card not included)
- Built-in logic level shifting for 3.3V ~ 5V operation

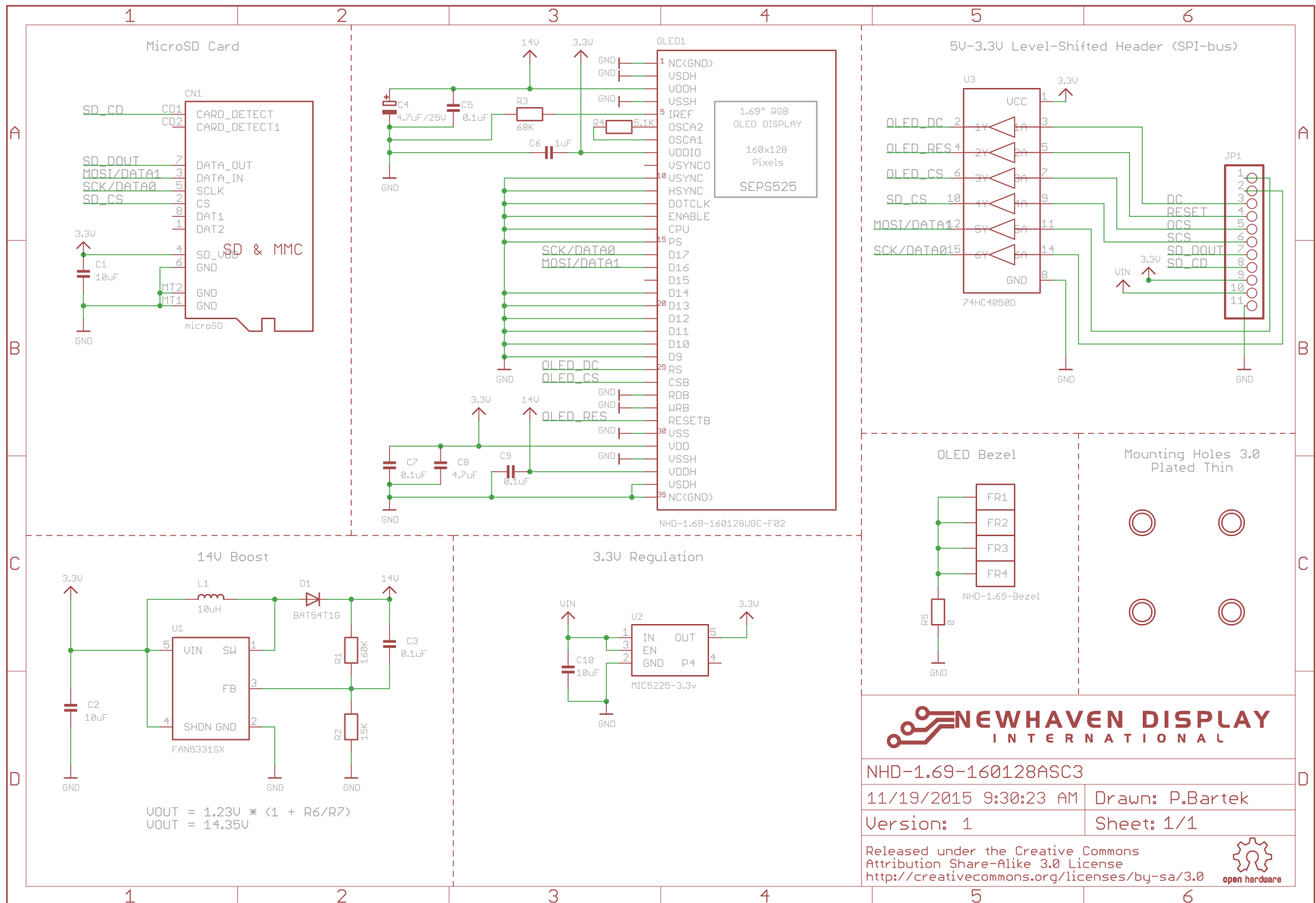
Mechanical Drawing

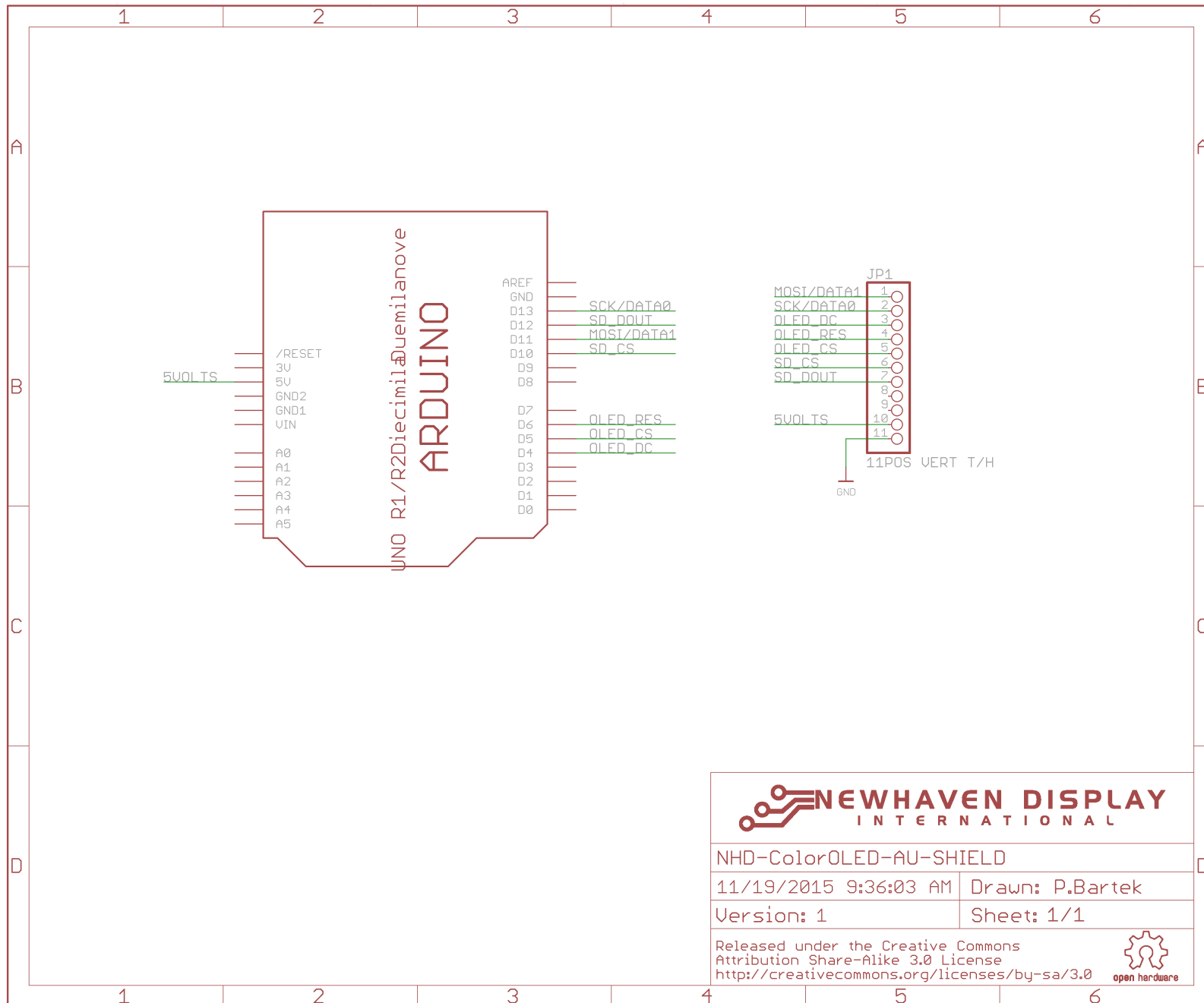


Rev	Description	Date

	Date 11/19/15	 NEWHAVEN DISPLAY INTERNATIONAL
Gen. Tolerance ±0.3mm	Unit mm	

Schematic





Interface Description

JP1 Interface:

Pin No.	Symbol	External Connection	Function Description
1	MOSI	MPU	Master Out Slave In
2	SCK	MPU	Serial Clock signal
3	D/C	MPU	Register Select signal. D/C=0: Command, D/C=1: Data
4	/RES	MPU	Active LOW Reset signal
5	OLEDCS	MPU	OLED Active LOW Chip Select signal
6	SDCS	MPU	Micro SD Active LOW Chip Select signal
7	MISO	MPU	Master In / Slave Out
8	NC	-	No Connect
9	NC	-	No Connect
10	VDD	Power Supply	Supply Voltage for OLED and logic (3.3V~5V)
11	GND	Power Supply	Ground

JP2 Interface:

Shield Pin Symbol	Arduino UNO Pin Symbol	Function Description
AREF	AREF	No Connect
GND	GND	Ground
Digital 13	13	Serial Clock signal
Digital 12	12	Master In / Slave Out
Digital 11	11	Master Out Slave In
Digital 10	10	Micro SD Active LOW Chip Select signal
Digital 9	9	No Connect
Digital 8	8	No Connect

JP3 Interface:

Shield Pin Symbol	Arduino UNO Pin Symbol	Function Description
Digital 7	7	No Connect
Digital 6	6	Active LOW Reset signal
Digital 5	5	OLED Active LOW Chip Select signal
Digital 4	4	Register Select signal. D/C=0: Command, D/C=1: Data
Digital 3	3	No Connect
Digital 2	2	No Connect
Digital 1	1	No Connect
Digital 0	0	No Connect

JP4 Interface:

Shield Pin Symbol	Arduino UNO Pin Symbol	Function Description
Analog 5	A5	No Connect
Analog 4	A4	No Connect
Analog 3	A3	No Connect
Analog 2	A2	No Connect
Analog 1	A1	No Connect
Analog 0	A0	No Connect

JP5 Interface:

Shield Pin Symbol	Arduino UNO Pin Symbol	Function Description
RST	RESET	No Connect
3V	3.3V	No Connect
5V	5V	Supply Voltage for OLED and logic (5V)
GND	GND	No Connect
GND	GND	No Connect
Vin	Vin	No Connect

Electrical Characteristics

Item	Symbol	Condition	Min.	Typ.	Max.	Unit
Operating Temperature Range	Top	Absolute Max	-30	-	+70	°C
Storage Temperature Range	Tst	Absolute Max	-40	-	+80	°C
Supply Voltage	VDD		3.0	3.3	5.5	V
Supply Current	IDD		-	95	220	mA
"H" Level input	Vih		0.8*VDD	-	VDD	V
"L" Level input	Vil		0	-	0.4	V
"H" Level output	Voh		VDD-0.4	-	-	V
"L" Level output	Vol		-	-	0.4	V

Optical Characteristics

Item	Symbol	Condition	Min.	Typ.	Max.	Unit
Viewing Angle – Top			80	-	-	°
Viewing Angle – Bottom			80	-	-	°
Viewing Angle – Left			80	-	-	°
Viewing Angle – Right			80	-	-	°
Contrast Ratio	Cr		-	2000:1	-	-
Response Time (rise)	Tr	-	-	10	-	us
Response Time (fall)	Tf	-	-	10	-	us
Brightness		50% checkerboard	60	75	-	cd/m ²
Lifetime		90 cd/m ² , Ta=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 SEPS525 controller.

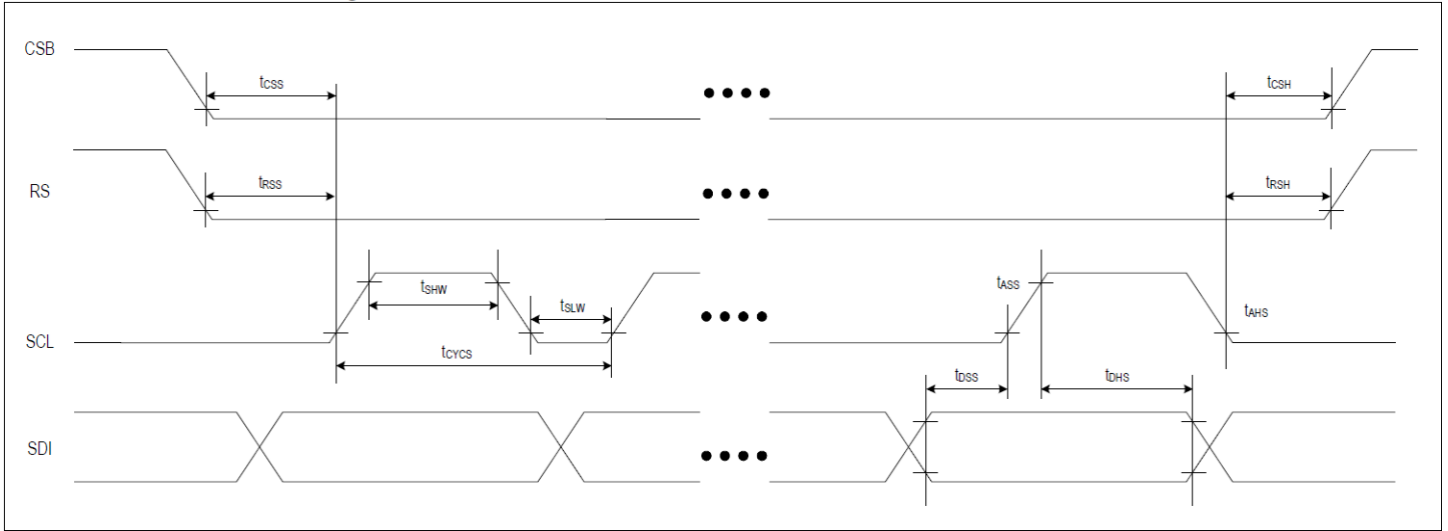
Please download specification at www.newhavendisplay.com/app_notes/SEPS525.pdf

Table of Commands

ADDR	RW	IB7	IB6	IB5	IB4	IB3	IB2	IB1	IB0	Description	Default
00h	R	IDX7	IDX6	IDX5	IDX4	IDX3	IDX2	IDX1	IDX0	INDEX	00h
01h	R	HC	VC	HV	SWAP	RD	CD	DC1	DC0	STATUS_RD	C0h
02h	R/W	SELEXP	SELRES	-	-	-	-	SELCLK	OSCD6B	OSC_CTL	C0h
80h	R/W	-	-	-	-	-	-	-	IREF	IREF	00h
03h	R/W	FR3	FR2	FR1	FR0	DFR3	DFR2	DFR1	DFR0	CLOCK_DIV	30h
04h	R/W	-	-	-	-	-	RC	OSCPS	PS	REDUCE_CURRENT	00h
05h	R/W	-	-	-	-	-	-	-	SRN	SOFT_RST	00h
06h	R/W	PREM	-	-	-	-	-	-	DON	DISP_ON_OFF	00h
08h	R/W	-	-	-	-	PTR3	PTR2	PTR1	PTR0	PRECHARGE_TIME_R	00h
09h	R/W	-	-	-	-	PTG3	PTG2	PTG1	PTG0	PRECHARGE_TIME_G	00h
0Ah	R/W	-	-	-	0	PTB3	PTB2	PTB1	PTB0	PRECHARGE_TIME_B	00h
0Bh	R/W	PCR7	PCR6	PCR5	PCR4	PCR3	PCR2	PCR1	PCR0	PRECHARGE_CURRENT_R	00h
0Ch	R/W	PCG7	PCC6	PCG5	PCC4	PCG3	PCG2	PCG1	PCG0	PRECHARGE_CURRENT_G	00h
0Dh	R/W	PCB7	PCB6	PCB5	PCB4	PCB3	PCB2	PCB1	PCB0	PRECHARGE_CURRENT_B	00h
10h	R/W	DCR7	DCR6	DCR5	DCR4	DCR3	DCR2	DCR1	DCR0	DRIVING_CURRENT_R	00h
11h	R/W	DCG7	DCG6	DCG5	DCG4	DCG3	DCG2	DCG1	DCG0	DRIVING_CURRENT_G	00h
12h	R/W	DCB7	DCB6	DCB5	DCB4	DCB3	DCB2	DCB1	DCB0	DRIVING_CURRENT_B	00h
13h	R/W	SWAP	SM	RD	CD	-	SPT	DC1	DC0	DISPLAY_MODE_SET	00h
14h	R/W	-	-	RIM1	RIM0	-	-	-	EDM	RGB_IF	11h
15h	R/W	RES	RES	ENP	DOP	VSYOEN	RES	RES	RES	RGB_POL	00h
16h	R/W	-	DFM1	DFM0	TRI	-	HC	VC	HV	MEMORY_WRITE_MODE	06h
17h	R/W	MX1_7	MX1_6	MX1_5	MX1_4	MX1_3	MX1_2	MX1_1	MX1_0	MX1_ADDR	00h
18h	R/W	MX2_7	MX2_6	MX2_5	MX2_4	MX2_3	MX2_2	MX2_1	MX2_0	MX2_ADDR	9Fh
19h	R/W	MY1_7	MY1_6	MY1_5	MY1_4	MY1_3	MY1_2	MY1_1	MY1_0	MY1_ADDR	00h
1Ah	R/W	MY2_7	MY2_6	MY2_5	MY2_4	MY2_3	MY2_2	MY2_1	MY2_0	MY2_ADDR	7Fh
20h	R/W	MAC7	MAC6	MAC5	MAC4	MAC3	MAC2	MAC1	MAC0	MEMORY_ACCESS_POINTER X	00h
21h	R/W	MAR7	MAR6	MAR5	MAR4	MAR3	MAR2	MAR1	MAR0	MEMORY_ACCESS_POINTER Y	00h
22h		DDRAM[17:0]								DDRAM_DATA_ACCESS_PORT	
50h	R/W	IGAMMA7	IGAMMA6	IGAMMA5	IGAMMA4	IGAMMA3	IGAMMA2	IGAMMA1	IGAMMA0	GRAY_SCALE_TABLE_INDEX	00h
51h	R/W	DGAMMA7	DGAMMA6	DGAMMA5	DGAMMA4	DGAMMA3	DGAMMA2	DGAMMA1	DGAMMA0	GRAY_SCALE_TABLE_DATA	
28h	R/W	DUTY7	DUTY6	DUTY5	DUTY4	DUTY3	DUTY2	DUTY1	DUTY0	DUTY	7Fh
29h	R/W	DSL7	DSL6	DSL5	DSL4	DSL3	DSL2	DSL1	DSL0	DSL	00h
2Eh	R/W	FAC7	FAC6	FAC5	FAC4	FAC3	FAC2	FAC1	FAC0	D1_DDRAM_FAC	00h
2Fh	R/W	FAR7	FAR6	FAR5	FAR4	FAR3	FAR2	FAR1	FAR0	D1_DDRAM_FAR	00h
31h	R/W	SAC7	SAC6	SAC5	SAC4	SAC3	SAC2	SAC1	SAC0	D2_DDRAM_SAC	00h
32h	R/W	SAR7	SAR6	SAR5	SAR4	SAR3	SAR2	SAR1	SAR0	D2_DDRAM_SAR	00h
33h	R/W	FX1_7	FX1_6	FX1_5	FX1_4	FX1_3	FX1_2	FX1_1	FX1_0	SCR1_FX1	00h
34h	R/W	FX2_7	FX2_6	FX2_5	FX2_4	FX2_3	FX2_2	FX2_1	FX2_0	SCR1_FX2	9Fh
35h	R/W	FY1_7	FY1_6	FY1_5	FY1_4	FY1_3	FY1_2	FY1_1	FY1_0	SCR1_FY1	00h
36h	R/W	FY2_7	FY2_6	FY2_5	FY2_4	FY2_3	FY2_2	FY2_1	FY2_0	SCR1_FY2	7Fh
37h	R/W	SX1_7	SX1_6	SX1_5	SX1_4	SX1_3	SX1_2	SX1_1	SX1_0	SCR2_SX1	00h
38h	R/W	SX2_7	SX2_6	SX2_5	SX2_4	SX2_3	SX2_2	SX2_1	SX2_0	SCR2_SX2	9Fh
39h	R/W	SY1_7	SY1_6	SY1_5	SY1_4	SY1_3	SY1_2	SY1_1	SY1_0	SCR2_SY1	00h
3Ah	R/W	SY2_7	SY2_6	SY2_5	SY2_4	SY2_3	SY2_2	SY2_1	SY2_0	SCR2_SY2	7Fh
3Bh	R/W	-	SSA1	SSA0	-	SSC1	SSC0	-	SSM	SCREEN_SAVER_CONTEROL	00h
3Ch	R/W	SST7	SST6	SST5	SST4	SST3	SST2	SST1	SST0	SS_SLEEP_TIMER	00h
3Dh	R/W	-	-	SMS1	SMS0	-	-	SMP1	SMP0	SCREEN_SAVER_MODE	00h
3Eh	R/W	FSUT7	FSUT6	FSUT5	FSUT4	FSUT3	FSUT2	FSUT1	FSUT0	SS_SCR1_FU	00h
3Fh	R/W	-	-	-	-	FSMS3	FSMS2	FSMS1	FSMS0	SS_SCR1_MXY	00h
40h	R/W	SSUT7	SSUT6	SSUT5	SSUT4	SSUT3	SSUT2	SSUT1	SSUT0	SS_SCR2_FU	00h
41h	R/W	SSMS7	SSMS6	SSMS5	SSMS4	SSMS3	SSMS2	SSMS1	SSMS0	SS_SCR2_MXY	00h
42h	R/W	-	-	SSMD1	SSMD0	-	-	-	-	MOVING_DIRECTION	00h
47h	R/W	ISX1_7	ISX1_6	ISX1_5	ISX1_4	ISX1_3	ISX1_2	ISX1_1	ISX1_0	SS_SCR2_SX1	00h
48h	R/W	ISX2_7	ISX2_6	ISX2_5	ISX2_4	ISX2_3	ISX2_2	ISX2_1	ISX2_0	SS_SCR2_SX2	00h
49h	R/W	ISY1_7	ISY1_6	ISY1_5	ISY1_4	ISY1_3	ISY1_2	ISY1_1	ISY1_0	SS_SCR2_SY1	00h
4Ah	R/W	ISY2_7	ISY2_6	ISY2_5	ISY2_4	ISY2_3	ISY2_2	ISY2_1	ISY2_0	SS_SCR2_SY2	00h

Timing Characteristics

4-wire SPI:



ITEM	SYMBOL	CONDITION	MIN	MAX	UNIT	PORT
Serial clock cycle	t_{CYCS}		100		ns	
SCL "H" pulse width	t_{SHW}	-	45	-	ns	SCL
SCL "L" pulse width	t_{SLW}		45		ns	
Data setup timing	t_{DSS}	-	5	-	ns	SDI
Data hold timing	t_{DHS}		5		ns	
CSB-SCL timing	t_{CSS}	-	5	-	ns	CSB
CSB-hold timing	t_{CSH}		5		ns	
RS-SCL timing	T_{RSS}	-	5	-	ns	RS
RS-hold timing	T_{RSH}		5		ns	

Example Initialization Sequence

```
void OLED_Init_160128RGB(void)
{
    digitalWrite(RES_PIN, LOW);
    delay(2);
    digitalWrite(RES_PIN, HIGH);
    delay(2);

    // display off, analog reset
    OLED_Command_160128RGB(0x04);
    OLED_Data_160128RGB(0x01);
    delay(1);

    // normal mode
    OLED_Command_160128RGB(0x04);
    OLED_Data_160128RGB(0x00);
    delay(1);

    // display off
    OLED_Command_160128RGB(0x06);
    OLED_Data_160128RGB(0x00);
    delay(1);

    // turn on internal oscillator using external resistor
    OLED_Command_160128RGB(0x02);
    OLED_Data_160128RGB(0x01);

    // 90 hz frame rate, divider 0
    OLED_Command_160128RGB(0x03);
    OLED_Data_160128RGB(0x30);

    // duty cycle 127
    OLED_Command_160128RGB(0x28);
    OLED_Data_160128RGB(0x7F);

    // start on line 0
    OLED_Command_160128RGB(0x29);
    OLED_Data_160128RGB(0x00);

    // rgb_if
    OLED_Command_160128RGB(0x14);
    OLED_Data_160128RGB(0x31);

    // Set Memory Write Mode
    OLED_Command_160128RGB(0x16);
    OLED_Data_160128RGB(0x76);
}
```

```

// driving current r g b (uA)
OLED_Command_160128RGB(0x10);
OLED_Data_160128RGB(0x45);
OLED_Command_160128RGB(0x11);
OLED_Data_160128RGB(0x34);
OLED_Command_160128RGB(0x12);
OLED_Data_160128RGB(0x33);

// precharge time r g b
OLED_Command_160128RGB(0x08);
OLED_Data_160128RGB(0x04);
OLED_Command_160128RGB(0x09);
OLED_Data_160128RGB(0x05);
OLED_Command_160128RGB(0x0A);
OLED_Data_160128RGB(0x05);

// precharge current r g b (uA)
OLED_Command_160128RGB(0x0B);
OLED_Data_160128RGB(0x9D);
OLED_Command_160128RGB(0x0C);
OLED_Data_160128RGB(0x8C);
OLED_Command_160128RGB(0x0D);
OLED_Data_160128RGB(0x57);

// Set Reference Voltage Controlled by External Resister
OLED_Command_160128RGB(0x80);
OLED_Data_160128RGB(0x00);

// mode set
OLED_Command_160128RGB(0x13);
OLED_Data_160128RGB(0xA0);

OLED_SetColumnAddress_160128RGB(0, 159);
OLED_SetRowAddress_160128RGB(0, 127);

// Display On
OLED_Command_160128RGB(0x06);
OLED_Data_160128RGB(0x01);
}

```

Example Arduino Code

Please see: https://github.com/NewhavenDisplay/NHD-1.69-160128ASC3_Example

Quality Information

Test Item	Content of Test	Test Condition	Note
High Temperature storage	Test the endurance of the display at high storage temperature.	+80°C , 96hrs	2
Low Temperature storage	Test the endurance of the display at low storage temperature.	-40°C , 96hrs	1,2
High Temperature Operation	Test the endurance of the display by applying electric stress (voltage & current) at high temperature.	+70°C 96hrs	2
Low Temperature Operation	Test the endurance of the display by applying electric stress (voltage & current) at low temperature.	-30°C , 96hrs	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 , 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.	-30°C,30min -> 25°C,5min -> 70°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