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NHD-1.27-12896ASC3

Graphic Color OLED Display Module

NHD-   Newhaven Display
1.27-   1.27" Diagonal Size
12896-   128 x 96 Pixels
AS-   Model
C-   Full Color
3-   +3.3V Power Supply

Newhaven Display International, Inc.

2661 Galvin Ct.

Elgin IL, 60124

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Document Revision History

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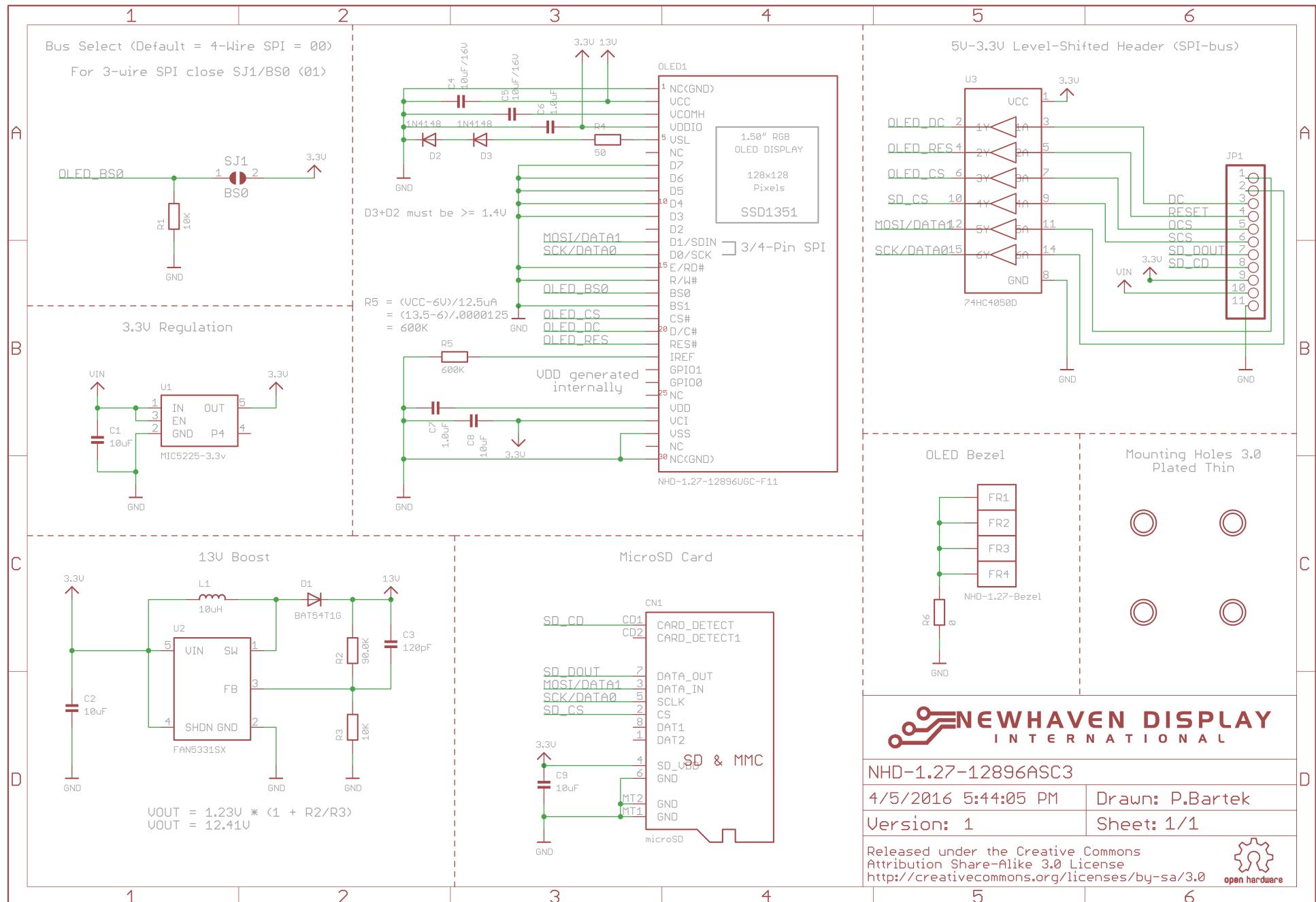
Functions and Features

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

Mechanical Drawing


	1	2	3	4	5	6

Rev | **Description** | **Date**

PCB 44.50 ± 0.3
4.85
8.895
(9.396)
9.55
BEZEL 34.80 ± 0.2
V.A 26.71 ± 0.2
(A.A 25.708)
P2.54*10= 25.40

5.10 ± 0.3
2.10 ± 0.2

3

4 - Ø3

MOSI SCK D/C /RES OLEDCS SDCS MISO CD 3Vo VDD GND

NEWHAVEN DISPLAY
INTERNATIONAL

NHD-1.27-12896ASC3

Active Area 1.27"
128(RGB) x 96 Pixels

PCB 58 ± 0.3
HOLES 52.60 ± 0.2
BEZEL 28 ± 0.2

(A.A 19.28)
V.A 20.28 ± 0.2

8.78

2.70
1.21
HOLE 39.10 ± 0.2
2.70

PCB 1

Pin Assignmnet

NO.	Symbol
1	MOSI
2	SCK
3	D/C
4	/RES
5	OLEDCS
6	SDCS
7	MISO
8	CD
9	3Vo
10	VDD
11	GND

0.201
0.181
0.067
0.047
0.016

R G B

0.201
0.185
0.02

DOTS DETAIL

	Date
	11/19/15

NEWHAVEN DISPLAY
INTERNATIONAL

Gen. Tolerance	Unit	Model:
±0.3mm	mm	NHD-1.27-12896ASC3

[3]

Schematic

Bus Select (Default = 4-Wire SPI = 00)

For 3-wire SPI close SJ1/BS0 (01)

OLED_BS0 — SJ1 — 3.3V
1 2
BS0
R1 10K
GND

3.3V Regulation

VIN — U1 — 3.3V
IN OUT
EN
GND P4
C1 10uF
GND
MIC5225-3.3v

13V Boost

3.3V — L1 10uH — D1 BAT54T1G — 13V
U2
VIN SW
FB
SHDN GND
FAN5331SX
R2 90.0K
C3 120pF
R3 10K
C2 10uF
GND

VOUT = 1.23V * (1 + R2/R3)
VOUT = 12.41V

3.3V 13V

C4 10uF/16V
C5 10uF/16V
C6 1.0uF
1N4148 1N4148
D2 D3
R4 50
GND

D3+D2 must be >= 1.4V

R5 = (VCC-6V)/12.5uA
   = (13.5-6)/.0000125
   = 600K

R5 600K

C7 1.0uF
C8 10uF
3.3V
GND

OLED1
1 NC(GND)
VCC
VCOMH
VDDIO
5 VSL
NC
D7
D6
D5
10 D4
D3
D2
D1/SDIN
D0/SCK
15 E/RD#
R/W#
BS0
BS1
CS#
20 D/C#
RES#
IREF
GPIO1
GPIO0
25 NC
VDD
VCI
VSS
NC
30 NC(GND)

1.50" RGB OLED DISPLAY
128x128 Pixels
SSD1351

3/4-Pin SPI

MOSI/DATA1
SCK/DATA0
OLED_BS0
OLED_CS
OLED_DC
OLED_RES

VDD generated internally

NHD-1.27-12896UGC-F11

MicroSD Card

CN1
SD_CD — CD1 CARD_DETECT
CD2 CARD_DETECT1
SD_DOUT 7 DATA_OUT
MOSI/DATA1 3 DATA_IN
SCK/DATA0 5 SCLK
SD_CS 2 CS
8 DAT1
1 DAT2

SD & MMC

3.3V
C9 10uF
GND
4 SD_VDD
6 GND
MT2
MT1
GND
GND
microSD

5V-3.3V Level-Shifted Header (SPI-bus)

U3
VCC
1
OLED_DC 2 1Y 1A 3
OLED_RES 4 2Y 2A 5
OLED_CS 6 3Y 3A 7
SD_CS 10 4Y 4A 9
MOSI/DATA1 12 5Y 5A 11
SCK/DATA0 15 6Y 6A 14
GND 8
74HC4050D
3.3V

JP1
1
2
3
DC 4
RESET
OCS 5
SCS 6
SD_DOUT 7
SD_CD 8
9
10
11
VIN 3.3V
GND
GND

OLED Bezel

FR1
FR2
FR3
FR4
NHD-1.27-Bezel
R6 0
GND

Mounting Holes 3.0 Plated Thin

Drawn: P.Bartek

NEWHAVEN DISPLAY INTERNATIONAL

NHD-1.27-12896ASC3

4/5/2016 5:44:05 PM

Version: 1

Sheet: 1/1

[4]

Interface Description

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	CD	MPU	Card Detect. Connect a 10K ohm pull-up resistor between this pin and a GPIO on the MPU to detect microSD card. This pin shorts to ground when microSD card is present.
9	3Vo	Power Supply	3.3V Output (No Connect)
10	VDD	Power Supply	Supply Voltage for OLED and logic (3.3V~5V)
11	GND	Power Supply	Ground

Jumper Communication Selection

Solder Jumper Name	4-wire Serial Interface	3-wire Serial Interface
SJ1	Open (default)	Short
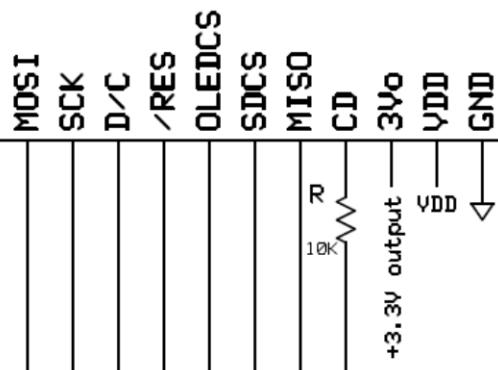
MPU Interface Pin Assignment Summary

Bus Interface	Data/Command Interface			Control Signals				
	MOSI	MISO	SCK	D/C	/RES	OLEDCS	SDCS	CD
4-wire SPI (default)	MOSI	MISO	SCK	D/C	/RES	OLEDCS	SDCS	CD
3-wire SPI	MOSI	MISO	SCK	Tie Low	/RES	OLEDCS	SDCS	CD

Wiring Diagrams
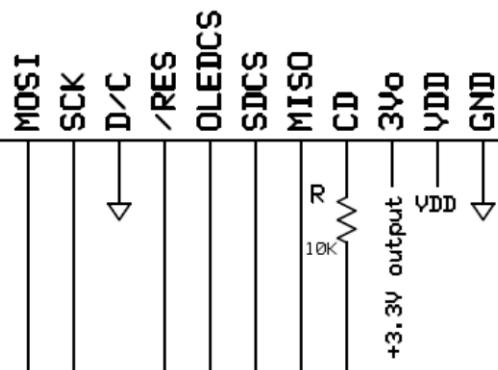
Electrical Characteristics

Item	Symbol	Condition	Min.	Typ.	Max.	Unit
Operating Temperature Range	T_{OP}	Absolute Max	-30	-	+70	ºC
Storage Temperature Range	T_{ST}	Absolute Max	-40	-	+80	ºC
Supply Voltage	V_{DD}	-	3.0	3.3	5.5	V
Supply Current	I_{DD}	V_{DD} = 3.3V	-	80	200	mA
Sleep Mode Current	IDD_{SLEEP}	-	-	2	10	µA
"H" Level input	V_{IH}	-	$0.8*V_{DD}$	-	V_{DD}	V
"L" Level input	V_{IL}	-	GND	-	$0.2*V_{DD}$	V
"H" Level output	V_{OH}	-	$0.9*V_{DD}$	-	V_{DD}	V
"L" Level output	V_{OL}	-	GND	-	$0.1*V_{DD}$	V

Optical Characteristics

Item		Symbol	Condition	Min.	Typ.	Max.	Unit
Optimal Viewing Angles	Top	φY+		80	-	-	º
	Bottom	φY-		80	-	-	º
	Left	θX-		80	-	-	º
	Right	θX+		80	-	-	º
Contrast Ratio		CR	-	-	2000:1	-	-
Response Time	Rise	T_R	-	-	10	-	us
	Fall	T_F	-	-	10	-	us
Brightness		L_V	50% checkerboard	80	100	-	cd/m²
Lifetime		-	90 cd/m², 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	D2	D0	Command	Description
0	15	0	0	0	1	0	1	0	1	Set Column Address	A[6:0]: Start Address. [reset=0]
1	A[6:0]	*	A_6	A_5	A_4	A_3	A_2	A_1	A_0		B[6:0]: End Address. [reset=127]
1	B[6:0]	*	B_6	B_5	B_4	B_3	B_2	B_1	B_0		Range from 0 to 127
0	75	0	1	1	1	0	1	0	1	Set Row Address	A[6:0]: Start Address. [reset=0]
1	A[6:0]	*	A_6	A_5	A_4	A_3	A_2	A_1	A_0		B[6:0]: End Address. [reset=127]
1	B[6:0]	*	B_6	B_5	B_4	B_3	B_2	B_1	B_0		Range from 0 to 127
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 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
1	A[7:0]	A_7	A_6	A_5	A_4	A_3	A_2	A_1	A_0		

Fundamental Command Table

D/C#	Hex	D7	D6	D5	D4	D3	D2	D2	D0	Command	Description
0	A1	1	0	1	0	0	0	0	1	Set Display Start Line	Set vertical scroll by RAM from 0~127. [reset=00h]
1	A[6:0]	*	A_6	A_5	A_4	A_3	A_2	A_1	A_0		
0	A2	1	0	1	0	0	0	1	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.
1	A[6:0]	*	A_6	A_5	A_4	A_3	A_2	A_1	A_0		
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	AB	1	0	1	0	1	0	1	1	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
1	A[7:0]	A_7	A_6	0	0	0	0	0	A_0		
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	B1	1	0	1	1	0	0	0	1	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.
1	A[7:0]	A_7	A_6	A_5	A_4	A_3	A_2	A_1	A_0		

[9]

Fundamental Command Table

D/C#	Hex	D7	D6	D5	D4	D3	D2	D2	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]
1	A[7:0]	A_7	A_6	A_5	A_4	A_3	A_2	A_1	A_0		$A[7:0]$ = A4h, $B[7:0]$ = 00h, $C[7:0]$ = 00h enhance display performance
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
1	A[7:0]	A_7	A_6	A_5	A_4	A_3	A_2	A_1	A_0		

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

$A[7:4]$ 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.

D/C#	Hex	D7	D6	D5	D4	D3	D2	D2	D0	Command	Description
0	B4	1	0	1	1	0	1	0	0	Set Segment Low Voltage (VSL)	$A[1:0]$=00 External VSL [reset]
1	A[7:0]	1	0	1	0	0	0	A_1	A_0		$A[1:0]$=01,10,11 are invalid
1	B[7:0]	1	0	1	1	0	1	0	1		**Note**
1	C[7:0]	0	1	0	1	0	1	0	1		[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
0	B5	1	0	1	1	0	1	0	1	Set GPIO	$A[1:0]$ GPIO0: 00 pin HiZ, Input disabled
1	A[3:0]	*	*	*	*	A_3	A_2	A_1	A_0		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
0	B6	1	0	1	1	0	1	0	0	Set Second Pre-charge Period	$A[3:0]$ Set Second Pre-charge Period
1	A[3:0]	*	*	*	*	A_3	A_2	A_1	A_0		0000b invalid
											0001b 1 DCLKS
											0010b 2 DCLKS
											....
											1000 8 DCLKS [reset]
											....
											1111 15 DCLKS

D/C#	Hex	D7	D6	D5	D4	D3	D2	D2	D0	Command	Description
0	B8	1	0	1	1	1	0	0	0		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)
1	A1[7:0]	$A1_7$	$A1_6$	$A1_5$	$A1_4$	$A1_3$	$A1_2$	$A1_1$	$A1_0$		
1	A2[7:0]	$A2_7$	$A2_6$	$A2_5$	$A2_4$	$A2_3$	$A2_2$	$A2_1$	$A2_0$		$A1[7:0]$: Gamma Setting for GS1,
1	.	.	.	.	.	.	.	.	.		$A2[7:0]$: Gamma Setting for GS2,
1	.	.	.	.	.	.	.	.	.		:
1	.	.	.	.	.	.	.	.	.		
1	A62[7:0]	$A62_7$	$A62_6$	$A62_5$	$A62_4$	$A62_3$	$A62_2$	$A62_1$	$A62_0$		$A62[7:0]$: Gamma Setting for GS62,
1	A63[7:0]	$A63_7$	$A63_6$	$A63_5$	$A63_4$	$A63_3$	$A63_2$	$A63_1$	$A63_0$	Look Up Table for Gray Scale Pulse width	$A63[7:0]$: Gamma Setting for GS63 Note [1] $0 \le$ 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.
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		
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		

For command BB (Set Pre-charge voltage):

A[4:0]	Hex code	pre-charge voltage
00000	00h	$0.20 \times V_{CC}$
:	:	:
11111	1Fh	$0.60 \times V_{CC}$

Note
[1] This command is locked by Command FDh by default. To unlock it, please refer to Command FDh.

For command BE (Set V_{COMH} Voltage):

A[2:0]	Hex code	V_{COMH}
000	00h	$0.72 \times V_{CC}$
:	:	:
101	05h	$0.82 \times V_{CC}$ [reset]
:	:	:
111	07h	$0.86 \times V_{CC}$

Note
[1] This command is locked by Command FDh by default. To unlock it, please refer to Command FDh.

Fundamental Command Table

Fundamental Command Table

D/C#	Hex	D7	D6	D5	D4	D3	D2	D2	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] B[7:0] Contrast Value Color B [reset=01010001b] C[7:0] Contrast Value Color C [reset=10001010b]
1	A[7:0]	A_7	A_6	A_5	A_4	A_3	A_2	A_1	A_0		
1	B[7:0]	B_7	B_6	B_5	B_4	B_3	B_2	B_1	B_0		
1	C[7:0]	C_7	C_6	C_5	C_4	C_3	C_2	C_1	C_0		
0	C7	1	1	0	0	0	1	1	1	Master Contrast Current Control	A[3:0] : 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]
1	A[3:0]	*	*	*	*	A_3	A_2	A_1	A_0		
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 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.
1	A[7:0]	A_7	A_6	A_5	A_4	A_3	A_2	A_1	A_0		

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

[12]

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

D/C#	Hex	D7	D6	D5	D4	D3	D2	D2	D0	Command	Description
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 $00111111b$
1	B[6:0]	0	B_6	B_5	B_4	B_3	B_2	B_1	B_0		Scroll towards SEG127 with 1 column offset
1	C[7:0]	C_7	C_6	C_5	C_4	C_3	C_2	C_1	C_0		$A[7:0] = 01000000b$ to $11111111b$
1	D[6:0]	0	D_6	D_5	D_4	D_3	D_2	D_1	D_0		Scroll towards SEG0 with 1 column offset
1	E[1:0]	0	0	0	0	0	0	E_1	E_0	Horizontal Scroll	$B[6:0]$: start row address $C[7:0]$: number of rows to be H-scrolled $B+C <= 128$ $D[6:0]$: 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
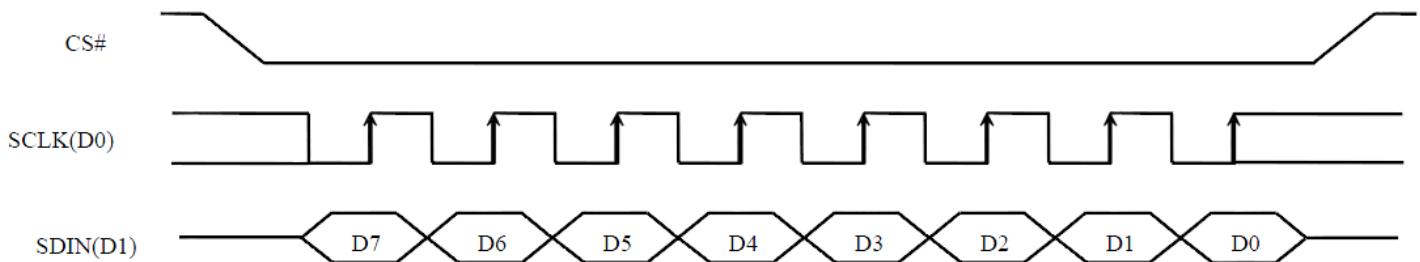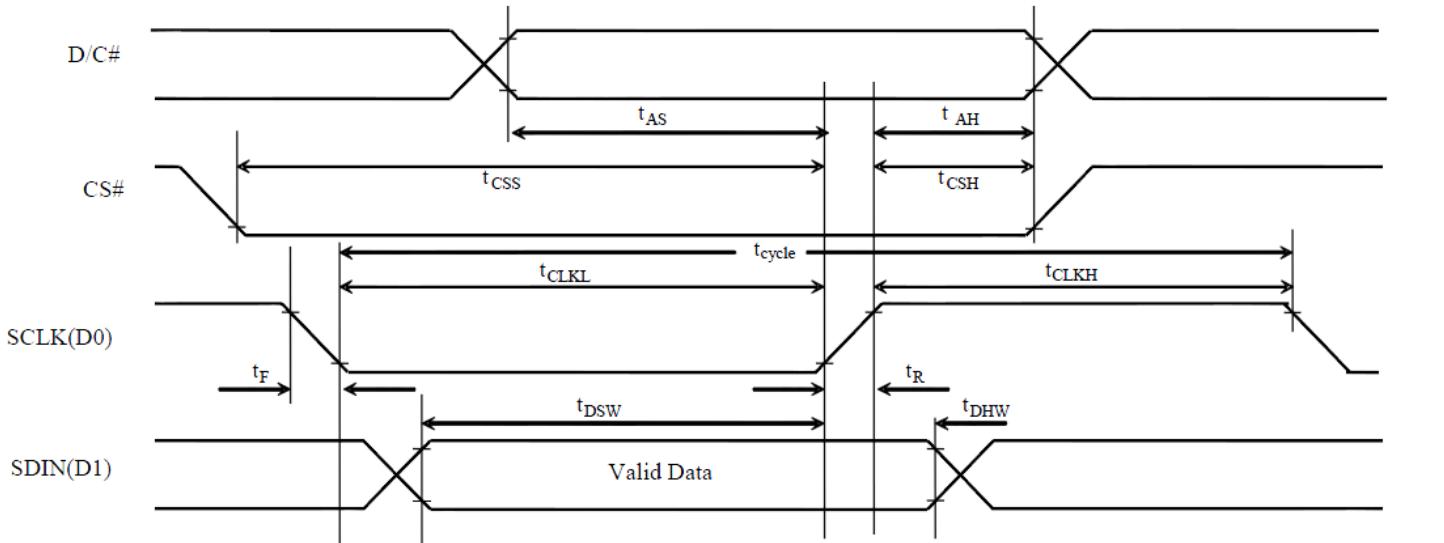
Note
[1] After executed the graphic command, waiting time is required for update GDDRAM content.
V_{CI} =2.4~3.5V, waiting time = 500ns/pixel.

[2] "*" stands for "Don't care".

Timing Characteristics
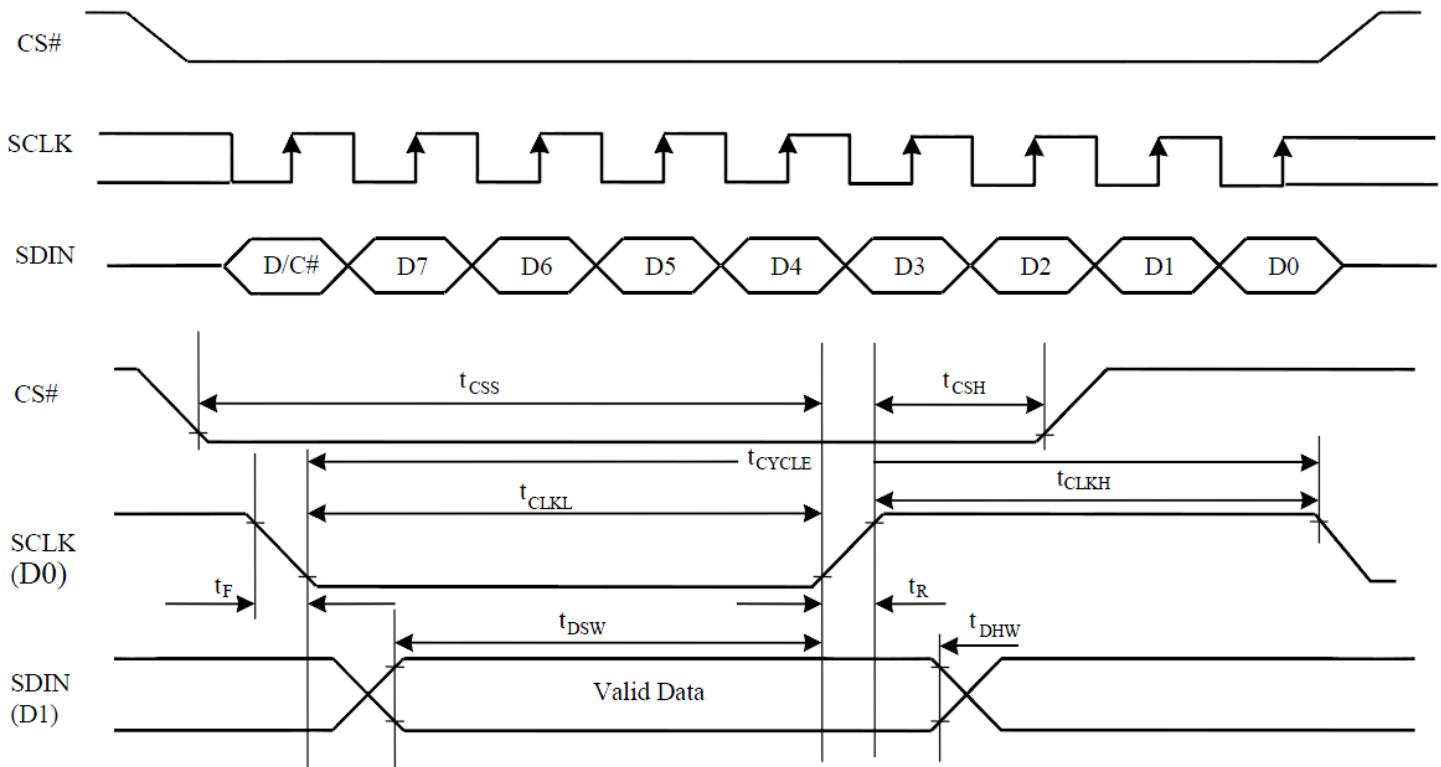
4-wire SPI:

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

3-wire SPI:

Symbol	Parameter	Min	Typ	Max	Unit
t_{cycle}	Clock Cycle Time	220	-	-	ns
t_{CSS}	Chip Select Setup Time	20	-	-	ns
t_{CSH}	Chip Select Hold Time	44	-	-	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);           //
```

[17]

```
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