NHD-1.69-128160ASC3

Graphic Color OLED Display Module

NHD-	Newhaven Display
1.69-	1.69” Diagonal Size
160128-	160 x 128 Pixels
AS-	Model
C-	Full Color
3-	+3.3V Power Supply

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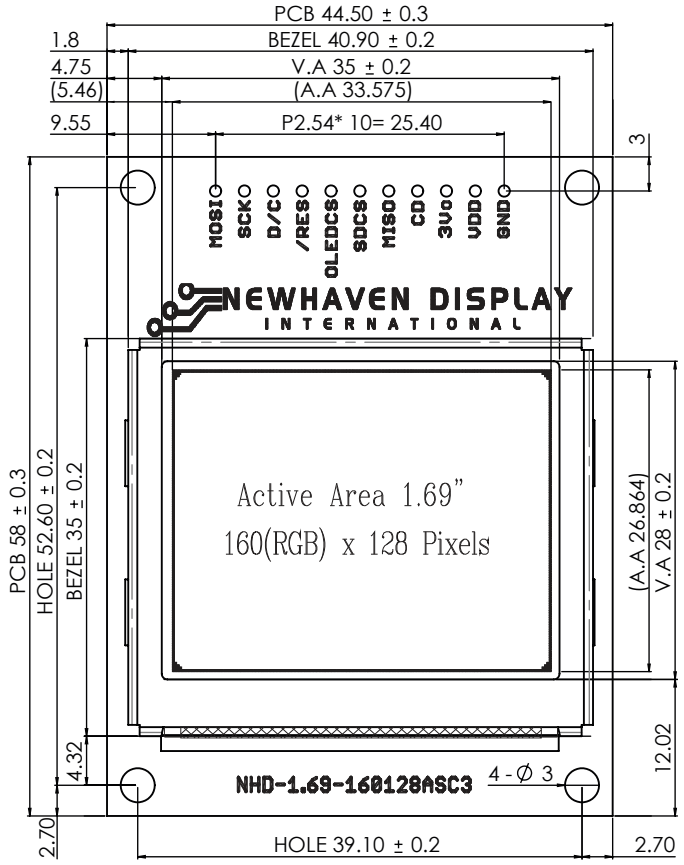
Document Revision History

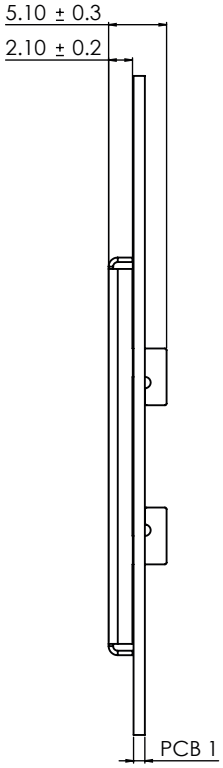
Revision	Date	Description	Changed by
0	11/19/2015	Initial Release	PB
1	01/11/2016	Functions and Features Updated	PB
2	03/01/2016	Example Initialization Sequence & Schematic Typo Updated	PB

Functions and Features

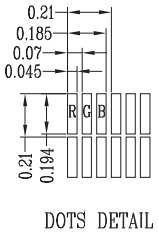
- **160 x 128 pixel resolution**
- **Built-in SEPS525 controller**
- **SPI MPU interface**
- **RoHS compliant**
- **microSD card reader (microSD card not included)**
- **Breadboard friendly**
- **Built-in logic level shifting for 3.3V ~ 5V operation**

Mechanical Drawing





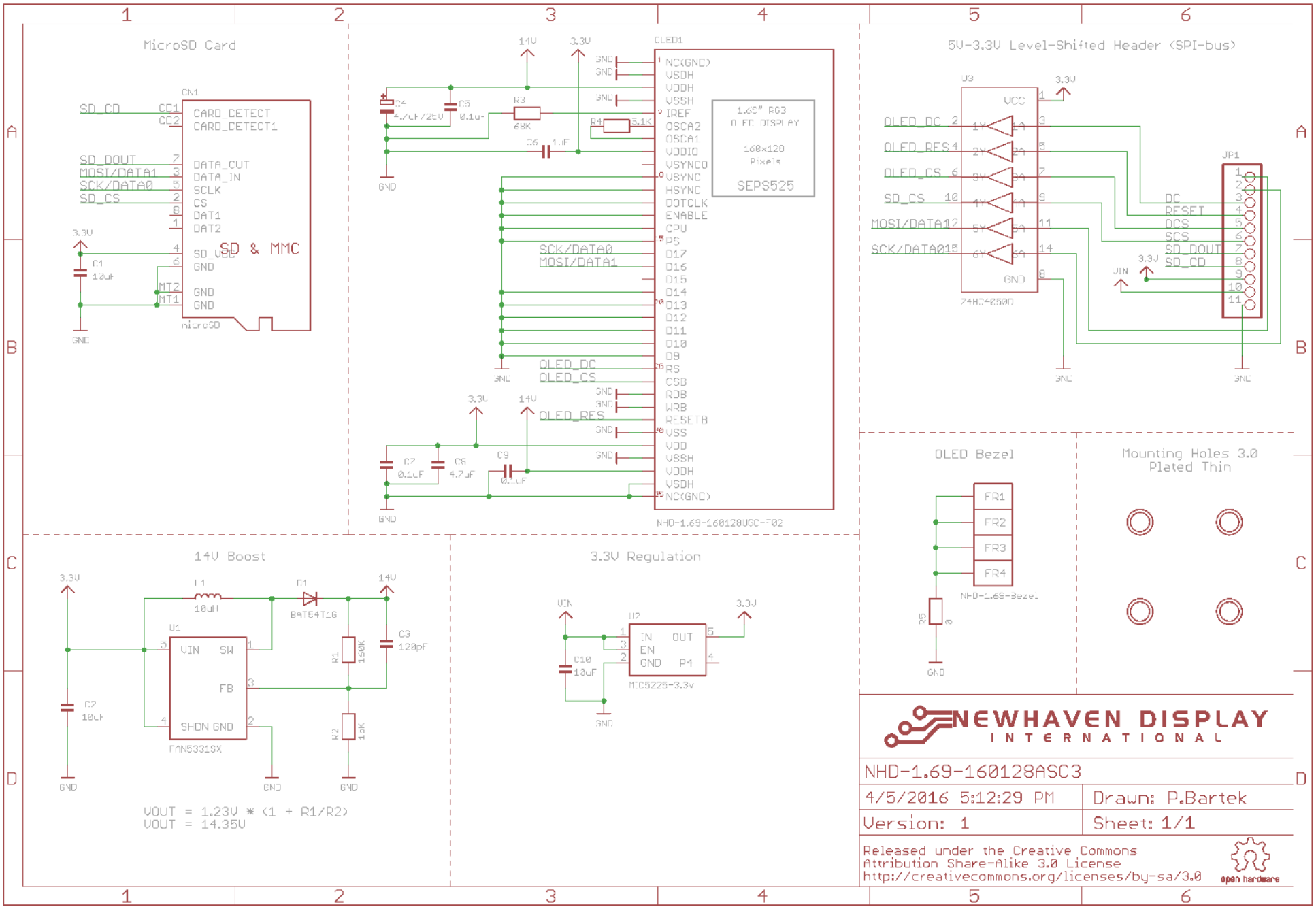
Pin Assignmnet	
NO.	Symbol
1	MOSI
2	SCK
3	D/C
4	/RES
5	OLEDCS
6	SDCS
7	MISO
8	CD
9	3Vo
10	VDD
11	GND



Rev	Description	Date

	Date	
	11/19/15	NEWHAVEN DISPLAY INTERNATIONAL
Gen. Tolerance ±0.3mm	Unit mm	Model: NHD-1.69-160128ASC3

Schematic


MicroSD Card
SD & MMC
microSD
5V-3.3V Level-Shifted Header (SPI-bus)
74HC4050D
OLED Bezel
Mounting Holes 3.0
Plated Thin
14V Boost
VOUT = 1.23V * (1 + R1/R2)
VOUT = 14.35V
3.3V Regulation
MIC5225-3.3v
NHD-1.69-160128UGC-FB2
NEWHAVEN DISPLAY
INTERNATIONAL
NHD-1.69-160128ASC3
4/5/2016 5:12:29 PM
Drawn: P.Bartek
Version: 1
Sheet: 1/1
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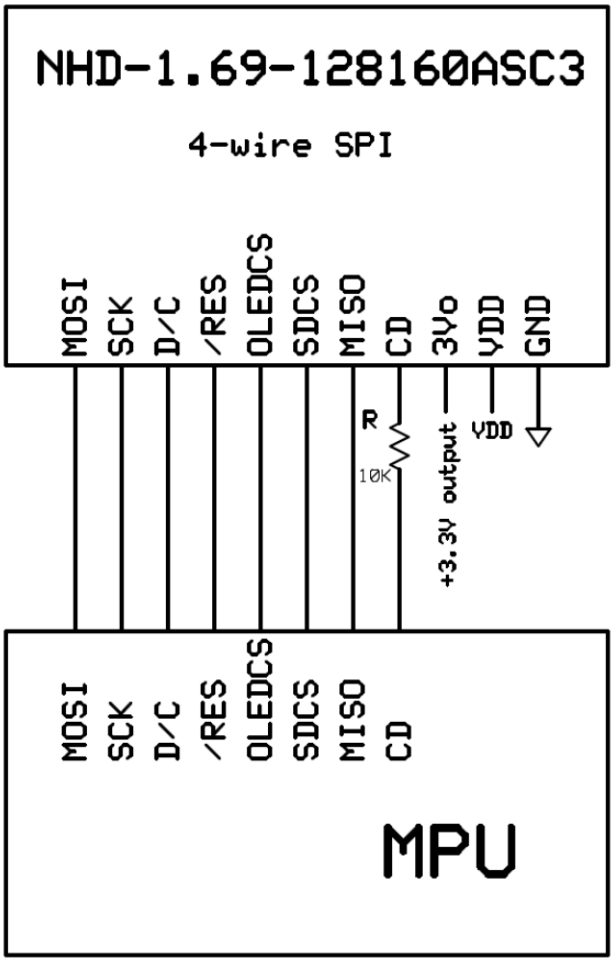
open hardware

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

Wiring Diagram



Electrical Characteristics

Item	Symbol	Condition	Min.	Typ.	Max.	Unit
Operating Temperature Range	Top	Absolute Max	-30	-	+70	ºC
Storage Temperature Range	Tst	Absolute Max	-40	-	+80	ºC
Supply Voltage	VDD		3.0	3.3	5.5	V
Supply Current	IDD		-	95	220	mA
Sleep Mode Current	IDD_{SLEEP}		-	5	10	µA
"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	-	-	º
Viewing Angle – Bottom			80	-	-	º
Viewing Angle – Left			80	-	-	º
Viewing Angle – Right			80	-	-	º
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

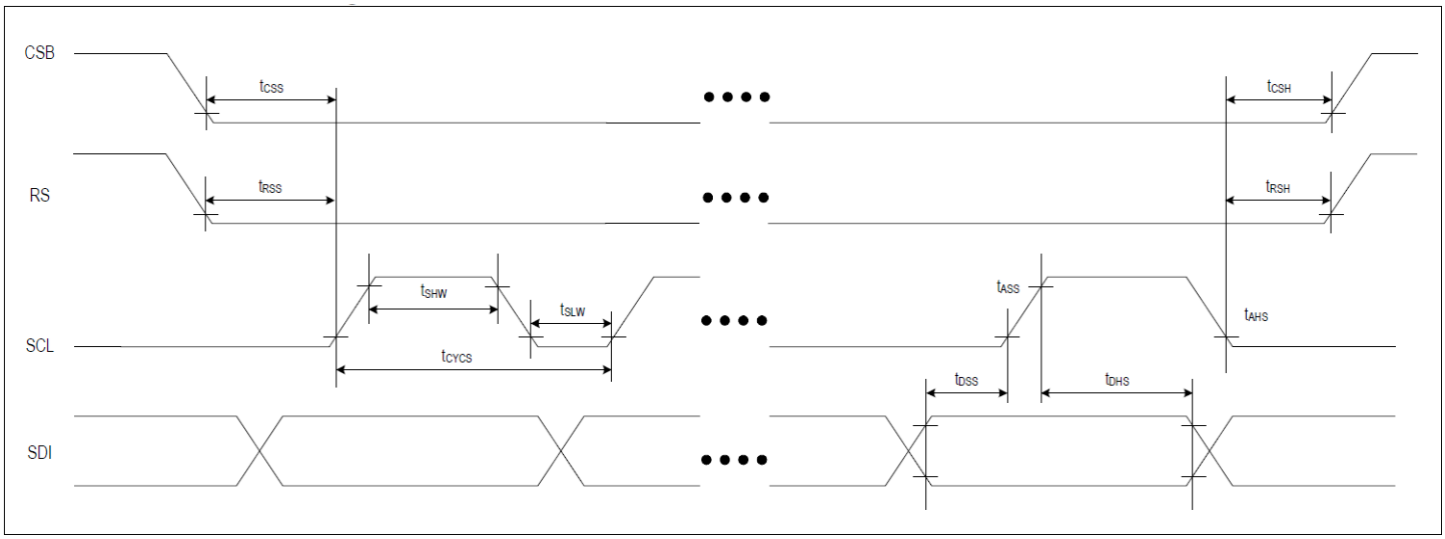
Built-in SEPS525 controller.
Please download specification at www.newhavendisplay.com/app_notes/SEPS525.pdf

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	OSCDSB	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	PCG6	PCG5	PCG4	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	-	-	-	EIM	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	-	-	SMF1	SMF0	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	ISX14	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
SCL "H" pulse width	t_{SHW}		45		ns	
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