NEWHAVEN DISPLAY INTERNATIONAL

Product Specification

NHD-3.12-25664UCY2

Graphic OLED Display Module

NHD -	Newhaven Display
3.12 -	3.12" Diagonal
25664 -	256x64 Pixel Resolution
UC -	Model
Y -	Emitting Color: Yellow
2 -	2.8V to 3.5V Operation

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REACH Compliant

RoHS Compliant

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Additional Resources

- **Support Forum:** https://support.newhavendisplay.com/hc/en-us/community/topics
- **GitHub:** https://github.com/newhavendisplay
- **Example Code:** https://support.newhavendisplay.com/hc/en-us/categories/4409527834135-Example-Code/
- **Knowledge Center:** https://www.newhavendisplay.com/knowledge_center.html
- **Quality Center:** https://www.newhavendisplay.com/quality_center.html
- **Precautions for using LCDs/LCMs:** https://www.newhavendisplay.com/specs/precautions.pdf
- **Warranty / Terms & Conditions:** https://www.newhavendisplay.com/terms.html

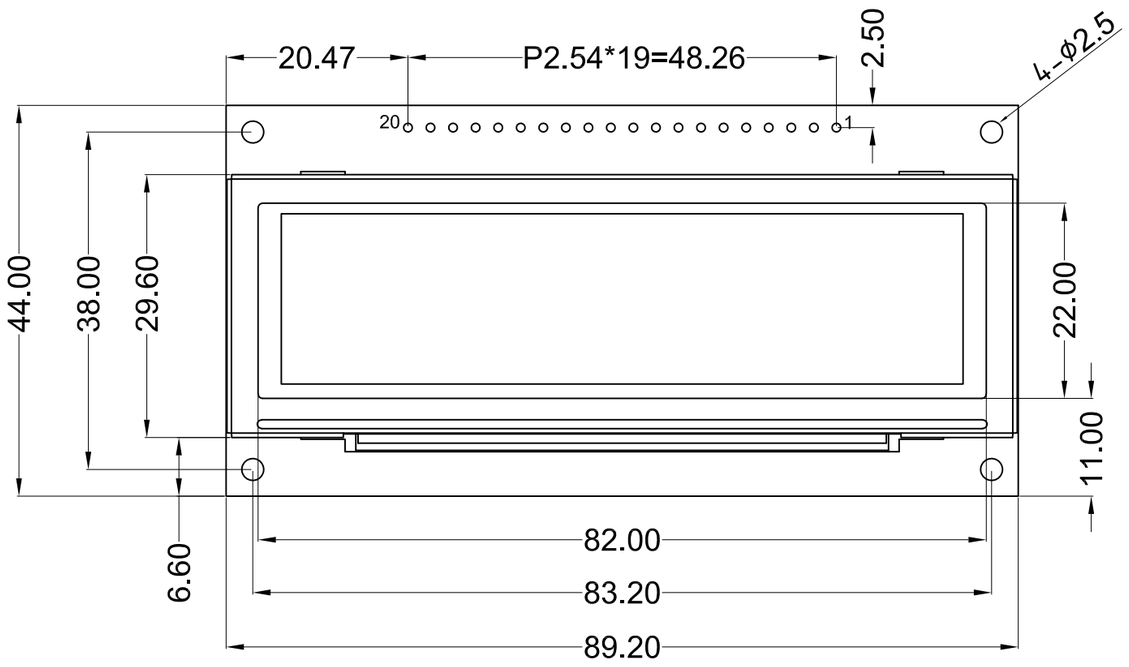
Document Revision History

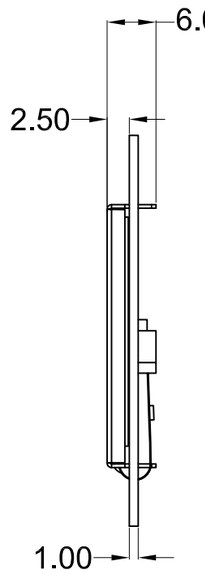
Revision	Date	Description	Changed By
0	05/01/2011	Initial Product Release	-
1	02/22/2013	Electrical characteristics and mechanical drawing updated	JN
2	05/02/2016	Supply Current Updated	SB
3	04/02/2020	Mechanical Characteristics Updated	SB
4	08/04/2020	Reformatted 2D Mechanical Drawings	AS
5	07/15/2022	PCB Redesign offering multiple driving methods. Updated Electrical characteristics, Mechanical Drawing.	JT
6	01/12/2023	Updated Mechanical Drawing	KL

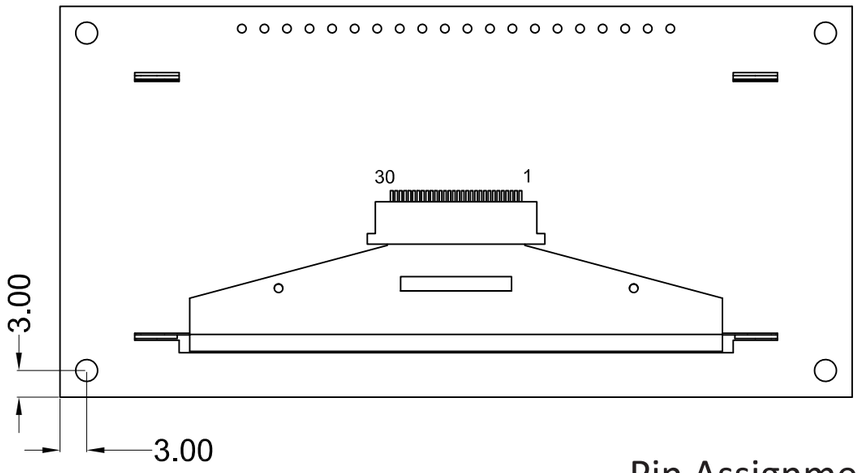
Mechanical Drawing

Newhaven Display
NHD-3.12-25664UCY2
Date Code

Part Label (type/format may vary)







Pin Assignment

Pin No.	Symbol
1	VSS
2	VDD
3	NC or BC_VDD
4	D/C
5	R/W or /WR
6	E or /RD
7-14	DB0 – DB7
15	NC or VCC
16	/RES
17	/CS
18	NC or G_VDD
19	BS1
20	BS0

Product Description: 3.12” 256x64 Graphic OLED

1. Driver IC: SSD1322
2. Interface: 8-bit 6800/8080 Parallel, 3/4-wire Serial
3. Power Requirement: 3.3V OLED
4. Optical Features: Yellow Color, Anti-Glare, Full View
5. Recommended Pin Header: 1x20 pin 2.54mm pitch

Standard Tolerance:
(Unless otherwise specified)
Linear: ±0.3mm

NEWHAVEN DISPLAY INTERNATIONAL

Drawing/Part Number:	Revision:
NHD-3.12-25664UCY2	-

Unless otherwise specified:
• Dimensions are in Millimeters
• Third Angle Projection

Drawn By:	Approved By:
K. Lewis	K. Lewis
Drawn Date: 01/12/2023	Approved Date: 01/12/2023

Pin Description

Parallel Interface:

Pin No.	Symbol	External Connection	Function Description
1	V_{SS}	Power Supply	Ground
2	V_{DD}	Power Supply	Supply Voltage for OLED and logic.
3	NC or BC_VDD	-	**Default:** No Connect **Supply Voltage for Boost Converter:** See Jumper Option #1
4	D/C	MPU	Register select signal. D/C=0: Command, D/C=1: Data
5	R/W or /WR	MPU	**6800-interface:** Read/Write select signal, R/W=1: Read, R/W=0: Write **8080-interface:** Active LOW Write signal.
6	E or /RD	MPU	**6800-interface:** Operation enable signal. Falling edge triggered. **8080-interface:** Active LOW Read signal.
7-14	DB0 – DB7	MPU	8-bit Bi-directional data bus lines.
15	NC or VCC	-	**Default:** No Connect **Supply Voltage for OLED Panel:** See Jumper Option #2
16	/RES	MPU	Active LOW Reset signal.
17	/CS	MPU	Active LOW Chip Select signal.
18	NC or G_VDD	-	**Default:** No Connect **Supply Voltage for Internal Regulator:** See Jumper Option #3
19	BS1	MPU	MPU Interface Select signal.
20	BS0	MPU	MPU Interface Select signal.

Serial Interface:

Pin No.	Symbol	External Connection	Function Description
1	V_{SS}	Power Supply	Ground
2	V_{DD}	Power Supply	Supply Voltage for OLED and logic.
3	NC or BC_VDD	-	**Default:** No Connect **Supply Voltage for Boost Converter:** See Jumper Option #1
4	D/C	MPU	Register select signal. D/C=0: Command, D/C=1: Data Tie LOW for 3-wire Serial Interface.
5-6	VSS	Power Supply	Ground
7	SCLK	MPU	Serial Clock signal.
8	SDIN	MPU	Serial Data Input signal.
9	NC	-	No Connect
10-14	VSS	Power Supply	Ground
15	NC or VCC	-	**Default:** No Connect **Supply Voltage for OLED Panel:** See Jumper Option #2
16	/RES	MPU	Active LOW Reset signal.
17	/CS	MPU	Active LOW Chip Select signal.
18	NC or G_VDD	-	**Default:** No Connect **Supply Voltage for Internal Regulator:** See Jumper Option #3
19	BS1	MPU	MPU Interface Select signal.
20	BS0	MPU	MPU Interface Select signal.

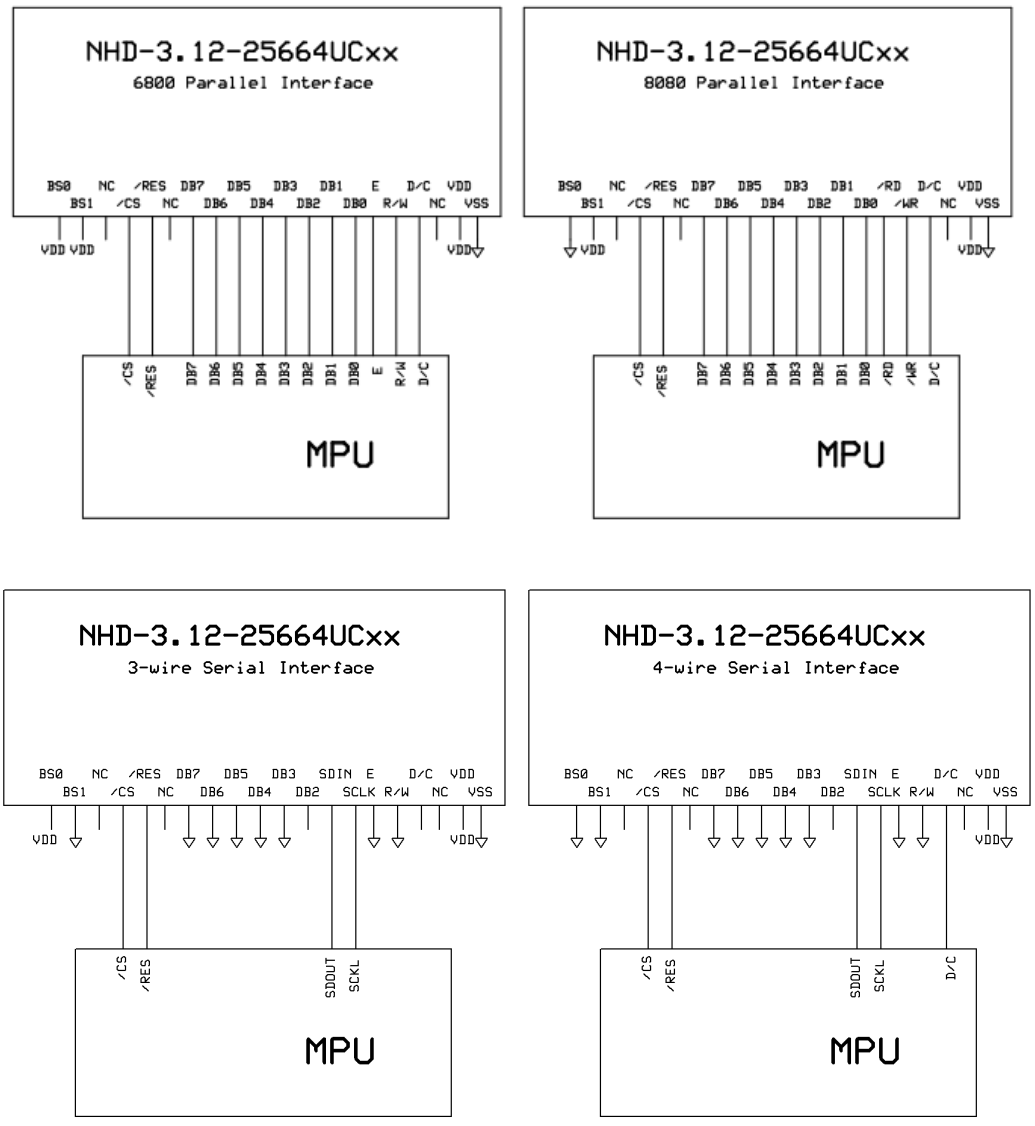
MPU Interface Pin Selections

Pin Name	6800 Parallel 8-bit interface	8080 Parallel 8-bit interface	3-wire Serial Interface	4-wire Serial Interface
BS1	1	1	0	0
BS0	1	0	1	0

MPU Interface Pin Assignment Summary

Bus Interface	Data/Command Interface								Control Signals				
	D7	D6	D5	D4	D3	D2	D1	D0	E	R/W	/CS	D/C	/RES
8-bit 6800	D[7:0]								E	R/W	/CS	D/C	/RES
8-bit 8080	D[7:0]								/RD	/WR	/CS	D/C	/RES
3-wire SPI	Tie LOW					NC	SDIN	SCLK	Tie LOW		/CS	Tie LOW	/RES
4-wire SPI	Tie LOW					NC	SDIN	SCLK	Tie LOW		/CS	D/C	/RES

Wiring Diagrams



On-Board Jumper Options

Default Jumper Setting

R14	R15	R18	R1	Description
Close	Open	Open	Open	**(default)** OLED Logic Circuit + Boost converter + OLED panel are powered from VDD (pin #2). This allows the full module to be powered by a single low-voltage supply.

Jumper Option #1 - Independent Supply Voltage for Boost Converter (BC_VDD)

R14	R15	R18	R1	Description
Open	**Close**	Open	Open	Boost converter + OLED panel are powered from BC_VDD (pin #3). OLED Logic Circuit is powered from VDD (pin #2). This allows for increased efficiency through the boost converter, by allowing a supply voltage up to +12V at its input, BC_VDD (pin #3).

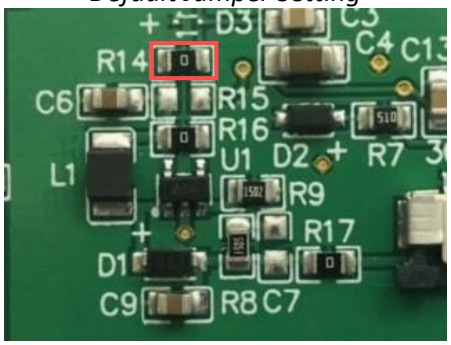
Jumper Option #2 – External Supply Voltage for OLED Panel (VCC)

R14	R15	R18	R1	Description
Open	Open	**Close**	Open	OLED panel is powered from VCC (pin #15) – boost converter is not used. OLED Logic Circuit is powered from VDD (pin #2). This allows for maximum module efficiency, and drastically reduced total current consumption.

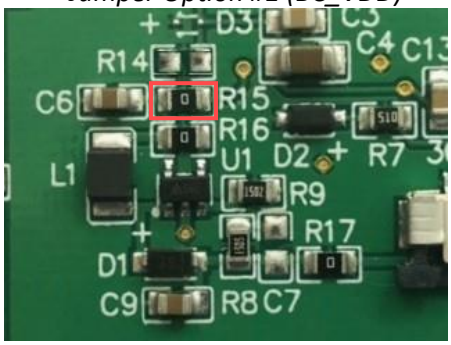
Jumper Option #3 – External Supply Voltage for Internal Regulator (G_VDD)

R14	R15	R18	R1	Description
See Description			**Close**	OLED Internal Regulator + Logic Circuit are powered from G_VDD (pin #18) – boost converter is powered from VDD (pin #2). Disabling the internal regulator reduces power consumption. Booster circuit must be driven by alternative method.

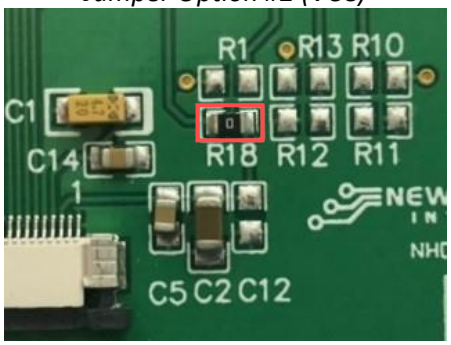
Default Jumper Setting



Jumper Option #1 (BC_VDD)



Jumper Option #2 (VCC)



Jumper Option #3 (G_VDD)

For detailed electrical information on each jumper option, please see the Electrical Characteristics table below.

Electrical Characteristics

Item	Symbol	Condition	Min.	Typ.	Max.	Unit
Operating Temperature Range	T_{op}	Absolute Max	-40	-	+85	°C
Storage Temperature Range	T_{st}	Absolute Max	-40	-	+90	°C
Default Jumper Setting						
Supply Voltage for Module	**VDD**	**-**	**2.8**	**3.3**	**3.5**	**V**
Supply Current for Module	**IDD**	**VDD=3.3V, 100% ON**	**-**	**310**	**340**	**mA**
Jumper Option #1						
Supply Voltage for Module	VDD	-	2.8	3.3	3.5	V
Supply Current for Module	IDD	V_{DD}=3.3V	-	170	200	µA
Supply Voltage for Boost Converter	BC_VDD	-	2.8	-	12	V
Supply Current for Boost Converter	BC_IDD	BC_VDD=5.0V, 100% ON	-	150	170	mA
		BC_VDD=12.0V, 100% ON	-	55	70	mA
Jumper Option #2						
Supply Voltage for Module	VDD	-	2.8	3.3	3.5	V
Supply Current for Module	IDD	V_{DD}=3.3V	-	170	200	µA
Supply Voltage for OLED Panel	VCC	-	11.5	12	12.5	V
Supply Current for OLED Panel	ICC	VCC=12V, 100% ON	-	45	55	mA
Jumper Option #3						
Supply Voltage for Logic	G_VDD	-	2.4	2.5	2.6	V
Supply Current for Module	G_IDD	VDD=3.3V	-	100	120	µA
Sleep Mode Current	IDD_{SLEEP}	-	-	25	120	µA
"H" Level input	V_{ih}	-	0.8*VDD	-	VDD	V
"L" Level input	V_{il}	-	VSS	-	0.2*VDD	V
"H" Level output	V_{oh}	-	0.9*VDD	-	VDD	V
"L" Level output	V_{ol}	-	VSS	-	0.1*VDD	V

Note: The electrical characteristics shown above for Jumper Option #1 and Jumper Option #2 apply only when the on-board jumpers are configured accordingly. By default, only Default Jumper Setting supply voltage and current (in bold) need to be considered. For details, see On-Board Jumper Options section on previous page.

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	T_{OP} = 25°C	60	80	-	cd/m²
Lifetime		-	50% Checkerboard	40,000	60,000	-	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 SSD1322 Controller: https://support.newhavendisplay.com/hc/en-us/articles/4414477846679-SSD1322

MPU Interface

6800-MPU Parallel Interface

The parallel interface consists of 8 bi-directional data pins, R/W, D/C, E, and /CS.
A LOW on R/W indicates write operation, and HIGH on R/W indicates read operation.
A LOW on D/C indicates "Command" read or write, and HIGH on D/C indicates "Data" read or write.
The E input serves as data latch signal, while /CS is LOW. Data is latched at the falling edge of E signal.

Function	E	R/W	/CS	D/C
Write Command	↓	0	0	0
Read Status	↓	1	0	0
Write Data	↓	0	0	1
Read Data	↓	1	0	1

8080-MPU Parallel Interface

The parallel interface consists of 8 bi-directional data pins, /RD, /WR, D/C, and /CS.
A LOW on D/C indicates "Command" read or write, and HIGH on D/C indicates "Data" read or write.
A rising edge of /RS input serves as a data read latch signal while /CS is LOW.
A rising edge of /WR input serves as a data/command write latch signal while /CS is LOW.

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

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

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

Serial Interface (4-wire)

The 4-wire serial interface consists of serial clock SCLK, serial data SDIN, D/C, and /CS.
D0 acts as SCLK and D1 acts as SDIN. D2 should be left open. D3~D7, E, and R/W should be connected to GND.

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

SDIN is shifted into an 8-bit shift register on every rising edge of SCLK in the order of D7, D6,…D0.
D/C is sampled on every eighth clock and the data byte in the shift register is written to the GDRAM or command register in the same clock. *Note: Read is not available in serial mode*

Serial Interface (3-wire)

The 3-wire serial interface consists of serial clock SCLK, serial data SDIN, and /CS.
D0 acts as SCLK and D1 acts as SDIN. D2 should be left open. D3~D7, E, R/W, and D/C should be connected to GND.

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

SDIN is shifted into an 9-bit shift register on every rising edge of SCLK in the order of D/C, D7, D6,…D0.
D/C (first bit of the sequential data) will determine if the following data byte is written to the Display Data RAM (D/C = 1) or the command register (D/C = 0). *Note: Read is not available in serial mode*

Example Initialization Sequence

```
Set_Command_Lock(0x12);                 // Unlock Basic Commands (0x12/0x16)
Set_Display_On_Off(0x00);               // Display Off (0x00/0x01)
Set_Column_Address(0x1C,0x5B);
Set_Row_Address(0x00,0x3F);
Set_Display_Clock(0x91);                // Set Clock as 80 Frames/Sec
Set_Multiplex_Ratio(0x3F);              // 1/64 Duty (0x0F~0x3F)
Set_Display_Offset(0x00);               // Shift Mapping RAM Counter (0x00~0x3F)
Set_Start_Line(0x00);                   // Set Mapping RAM Display Start Line (0x00~0x7F)
Set_Remap_Format(0x14);                 // Set Horizontal Address Increment
                                        //    Column Address 0 Mapped to SEG0
                                        //    Disable Nibble Remap
                                        //    Scan from COM[N-1] to COM0
                                        //    Disable COM Split Odd Even
                                        //    Enable Dual COM Line Mode
Set_GPIO(0x00);                         // Disable GPIO Pins Input
Set_Function_Selection(0x01);           // Enable Internal VDD Regulator
Set_Display_Enhancement_A(0xA0,0xFD);       // Enable External VSL
Set_Contrast_Current(0x9F);             // Set Segment Output Current
Set_Master_Current(0x0F);               // Set Scale Factor of Segment Output Current Control
//Set_Gray_Scale_Table();               // Set Pulse Width for Gray Scale Table
Set_Linear_Gray_Scale_Table();          //set default linear gray scale table
Set_Phase_Length(0xE2);                 // Set Phase 1 as 5 Clocks & Phase 2 as 14 Clocks
Set_Display_Enhancement_B(0x20);        // Enhance Driving Scheme Capability (0x00/0x20)
Set_Precharge_Voltage(0x1F);            // Set Pre-Charge Voltage Level as 0.60*VCC
Set_Precharge_Period(0x08);             // Set Second Pre-Charge Period as 8 Clocks
Set_VCOMH(0x07);                        // Set Common Pins Deselect Voltage Level as 0.86*VCC
Set_Display_Mode(0x02);                 // Normal Display Mode (0x00/0x01/0x02/0x03)
Set_Partial_Display(0x01,0x00,0x00);    // Disable Partial Display
Set_Display_On_Off(0x01);
```

Quality Information

Test Item	Content of Test	Test Condition	Note
High Temperature storage	Test the endurance of the display at high storage temperature.	+90°C, 240hrs	2
Low Temperature storage	Test the endurance of the display at low storage temperature.	-40°C, 240hrs	1,2
High Temperature Operation	Test the endurance of the display by applying electric stress (voltage & current) at high temperature.	+85°C, 240hrs	2
Low Temperature Operation	Test the endurance of the display by applying electric stress (voltage & current) at low temperature.	-40°C, 240hrs	1,2
High Temperature / Humidity Operation	Test the endurance of the display by applying electric stress (voltage & current) at high temperature with high humidity.	+60°C, 90% RH, 240hrs	1,2
Thermal Shock resistance	Test the endurance of the display by applying electric stress (voltage & current) during a cycle of low and high temperatures.	-40°C,30min -> 25°C,5min -> 85°C,30min = 1 cycle 100 cycles	
Vibration test	Test the endurance of the display by applying vibration to simulate transportation and use.	10-22Hz, 1.5mm 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