NHD-0216K1Z-FS(RGB)FBW-REV1

Character Liquid Crystal Display Module

NHD-	Newhaven Display
0216-	2 lines x 16 characters
K1Z-	Model
FS-	Transflective
RGB-	Side backlight RED, GREEN, BLUE
F-	FSTN (+)
B-	6:00 view
W-	Wide Temperature (-20°C ~ +70°C)
REV1-	Revision 1
	RoHS Compliant

Newhaven Display International, Inc.
2511 Technology Drive, Suite 101
Elgin IL, 60124
Ph: 847-844-8795 Fax: 847-844-8796

www.newhavendisplay.com
nhtech@newhavendisplay.com nhsales@newhavendisplay.com

Document Revision History

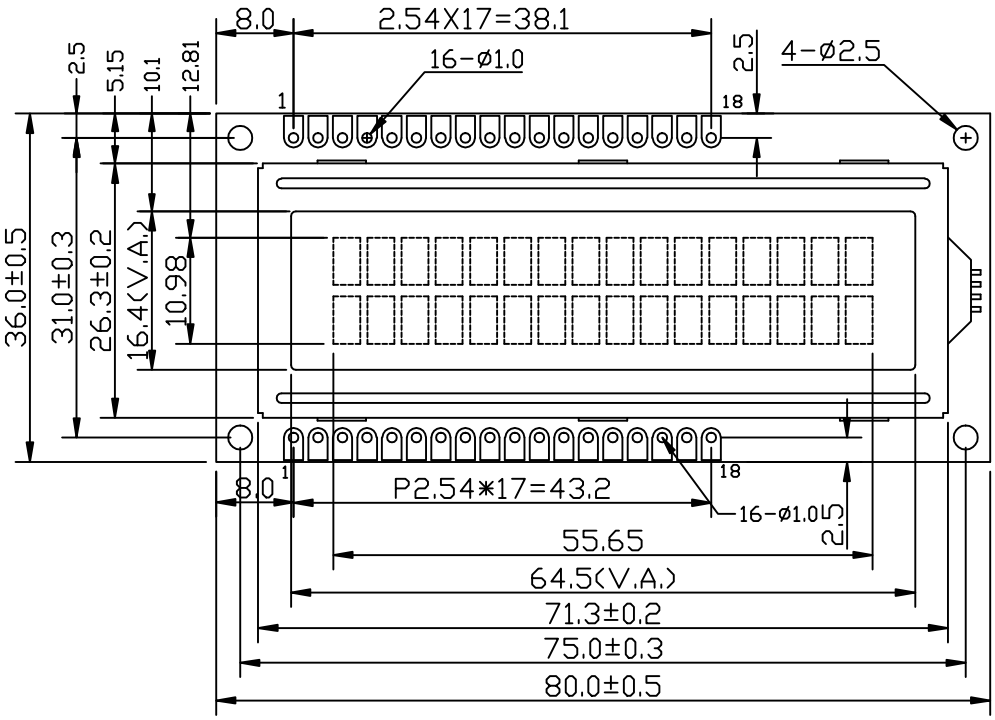
Revision	Date	Description	Changed by
0	1/23/2006	Initial Release	-
1	6/4/2009	User Guide Reformat	-
2	9/16/2009	Backlight Revision	BE
3	10/23/2009	Block Diagram/Initialization/electrical Revision	BE
4	1/7/2010	Optical revised	BE

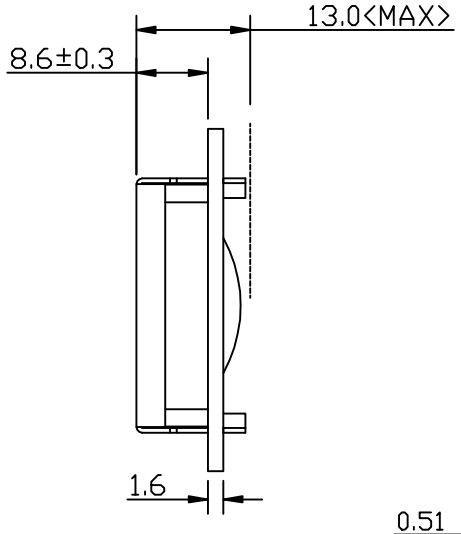
Functions and Features

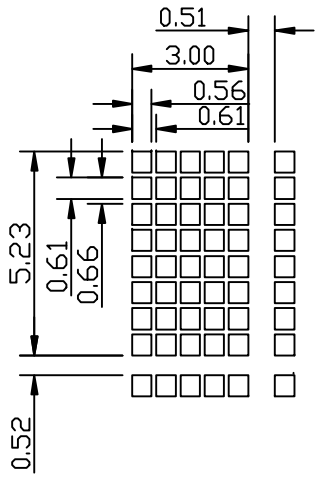
- **2 lines x 16 characters**
- **Built-in controller (SPLC780D or equivalent)**
- **Red, Green and Blue Backlights**
- **+5.0V power supply**
- **1/16 duty, 1/5 bias**
- **RoHS Compliant**

Mechanical Drawing

REV	DESCRIPTION:	DATE
1.0	First	







PIN ASSIGNMENT

1	VSS
2	VDD
3	V0
4	RS
5	RW
6	E
7	DB0
8	DB1
9	DB2
10	DB3
11	DB4
12	DB5
13	DB6
14	DB7
15	LED-
16	A-RED
17	A-GREEN
18	A-BLUE

Notes:

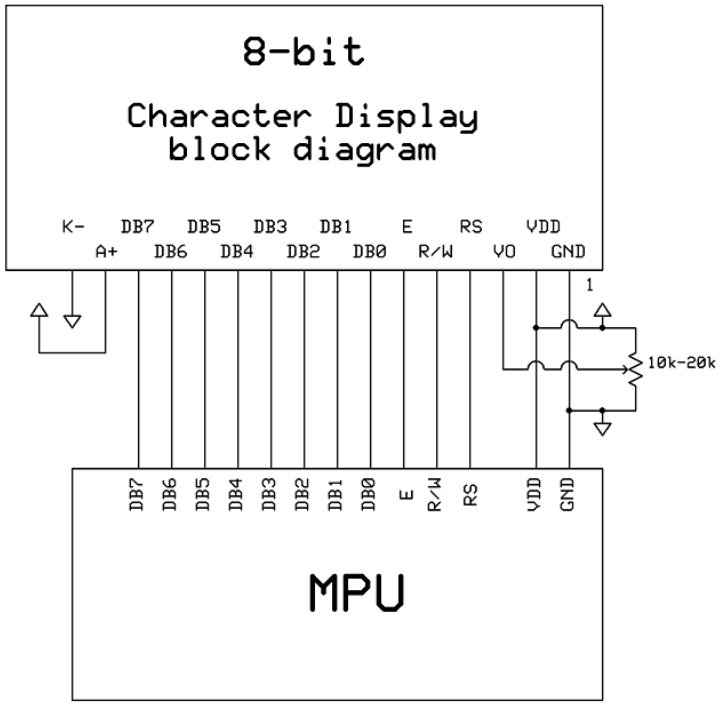
1.) Driver Method: 1/16 duty, 1/5 bias, VDD5.0V VLCD 4.5V
2.) Display Type: FSTN/Positive/6:00 View
3.) Operating Temp: -20 ℃~70℃/Storage Temp: -30℃~80℃
4.) Backlight Type: Side/R,G,B
5.) Driver: SPLC780D/4bit or 8bit MPU
6.) RoHS Compliant

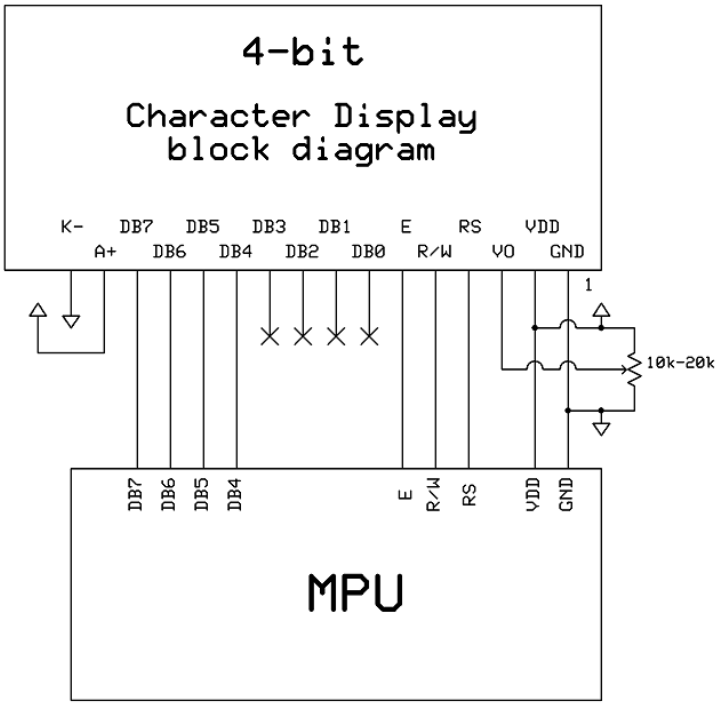
Model Name: NHD-0216K1Z-FS(RGB)-FBW-REV1	Newhaven Display
GENERAL TOL: ± 0.2	
APPROVALS / DATE	DRAWN NO. / SCALE: 1:1
DWN: Qipei Qiu	
CHK:	SIZE: A4 / UNIT: mm / Page: 1-1
APP: Guoxiang Ye	

Pin Description and Wiring Diagram

Pin No.	Symbol	External Connection	Function Description
1	V_{SS}	Power Supply	Ground
2	V_{DD}	Power Supply	Power supply for logic (+5.0V)
3	V_0	Adj. Power Supply	Power supply for contrast (approx. 0.5V)
4	RS	MPU	Register select signal RS=1: DATA RS=0: COMMAND
5	R/W	MPU	Read/Write select signal RW=1: READ RW=0: WRITE
6	E	MPU	Operation enable signal Falling Edge Triggered
7-10	DB0 – DB3	MPU	Four low order bi-directional three-state data bus lines. These four are not used during 4-bit operation
11-14	DB4 – DB7	MPU	Four high order bi-directional three-state data bus lines.
15	LED-	Power Supply	Ground for Backlight
16	LED-RED	Power Supply	Power supply for backlight (2.2V)
17	LED-GREEN	Power Supply	Power supply for backlight (3.3V)
18	LED-BLUE	Power Supply	Power supply for backlight (3.3V)

Recommended LCD connector: 2.54mm pitch 1x18 pin header
Backlight connector: Pins 15-18 of LCD connector **Mates with**: -





Electrical Characteristics

Item	Symbol	Condition	Min.	Typ.	Max.	Unit
Operating Temperature Range	Top		-20	-	+70	°C
Storage Temperature Range	Tst		-30	-	+80	°C
Supply Voltage	VDD		4.7	5.0	5.5	V
Supply Current	IDD		-	1.5	2.5	mA
Supply for LCD (contrast)	VDD-V0	Ta=25°C	-	4.5	-	V
"H" Level input	Vih		2.2	-	VDD	V
"L" Level input	Vil		0	-	0.6	V
"H" Level output	Voh		2.4	-	-	V
"L" Level output	Vol		-	-	0.4	V
Backlight Supply Voltage – RED	Vled	Ta=25°C	-	2.2	-	V
Backlight Supply Current – RED	Iled	Ta=25°C, Vled=2.2V	-	20	30	mA
Backlight Supply Voltage – GREEN	Vled	Ta=25°C	-	3.3	-	V
Backlight Supply Current – GREEN	Iled	Ta=25°C, Vled=3.3V	-	20	30	mA
Backlight Supply Voltage – BLUE	Vled	Ta=25°C	-	3.3	-	V
Backlight Supply Current – BLUE	Iled	Ta=25°C, Vled=3.3V	-	20	30	mA

Optical Characteristics

Item	Symbol	Condition	Min.	Typ.	Max.	Unit
Viewing Angle - Vertical (Top)	AV	Cr ≥ 3	-	20	-	º
Viewing Angle - Vertical (bottom)	AV	Cr ≥ 3	-	50	-	º
Viewing Angle - Horizontal (left)	AH	Cr ≥ 3	-	30	-	º
Viewing Angle - Horizontal (right)	AH	Cr ≥ 3	-	30	-	º
Contrast Ratio	Cr		3	5	-	-
Response Time (rise)	Tr	-	-	150	250	ms
Response Time (fall)	Tf	-	-	150	250	ms

Controller Information

Built-in SPLC780D-001. Download specification at http://www.newhavendisplay.com/app_notes/SPLC780D.pdf

Table of Commands

Instruction	Instruction code										Description	Execution time (fosc= 270 KHZ
	RS	R/W	DB7	DB6	DB 5	DB4	DB3	DB2	DB 1	DB0		
Clear Display	0	0	0	0	0	0	0	0	0	1	Write "20H" to DDRA and set DDRAM address to "00H" from AC	1.53ms
Return Home	0	0	0	0	0	0	0	0	1	-	Set DDRAM address to "00H" From AC and return cursor to Its original position if shifted. The contents of DDRAM are not changed.	1.53ms
Entry mode Set	0	0	0	0	0	0	0	1	I/D	SH	Assign cursor moving direction And blinking of entire display	39us
Display ON/ OFF control	0	0	0	0	0	0	1	D	C	B	Set display (D), cursor (C), and Blinking of cursor (B) on/off Control bit.	
Cursor or Display shift	0	0	0	0	0	1	S/C	R/L	-	-	Set cursor moving and display Shift control bit, and the Direction, without changing of DDRAM data.	39us
Function set	0	0	0	0	1	DL	N	F	-	-	Set interface data length (DL: 8- Bit/4-bit), numbers of display Line (N: =2-line/1-line) and, Display font type (F: 5x11/5x8)	39us
Set CGRAM Address	0	0	0	1	AC5	AC4	AC3	AC2	AC1	AC0	Set CGRAM address in address Counter.	39us
Set DDRAM Address	0	0	1	AC6	AC5	AC4	AC3	AC2	AC1	AC0	Set DDRAM address in address Counter.	39us
Read busy Flag and Address	0	1	BF	AC6	AC5	AC4	AC3	AC2	AC1	AC0	Whether during internal Operation or not can be known By reading BF. The contents of Address counter can also be read.	0us
Write data to Address	1	0	D7	D6	D5	D4	D3	D2	D1	D0	Write data into internal RAM (DDRAM/CGRAM).	43us
Read data From RAM	1	1	D7	D6	D5	D4	D3	D2	D1	D0	Read data from internal RAM (DDRAM/CGRAM).	43us

Display character address code:

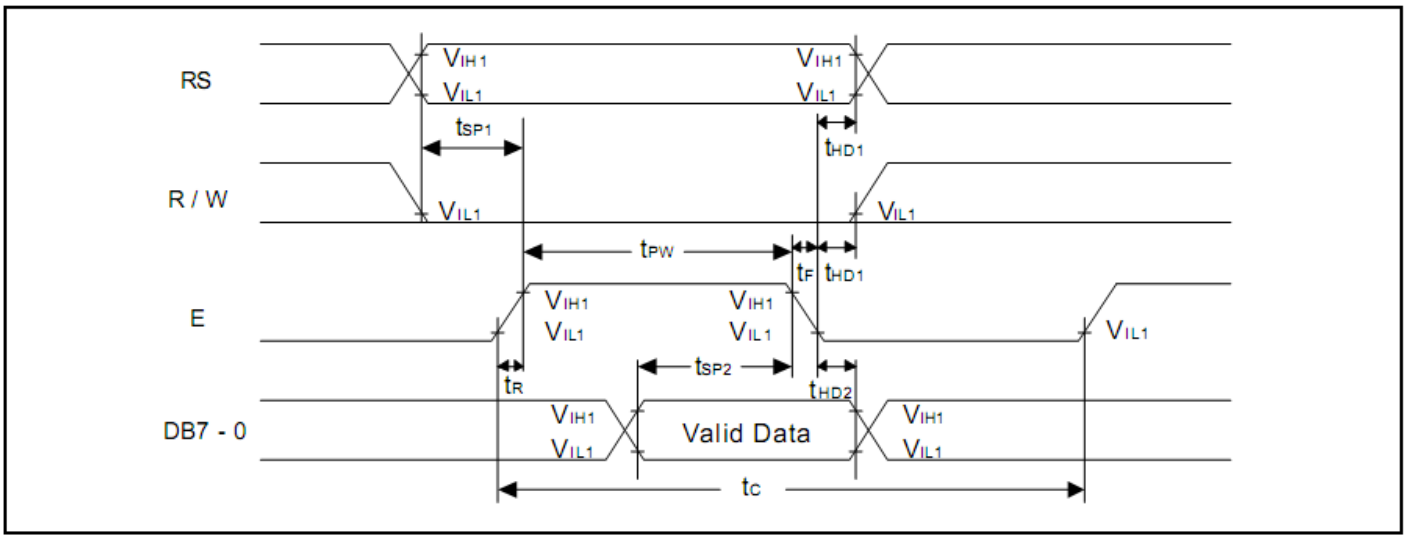
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
00	01	02	03	04	05	06	07	08	09	0A	0B	0C	0D	0E	0F
40	41	42	43	44	45	46	47	48	49	4A	4B	4C	4D	4E	4F

Timing Charateristics

6.5.3. Write mode (Writing Data from MPU to SPLC780D)

Characteristics	Symbol	Limit			Unit	Test Condition
		Min.	Typ.	Max.		
E Cycle Time	t_C	500	-	-	ns	Pin E
E Pulse Width	t_{PW}	230	-	-	ns	Pin E
E Rise/Fall Time	t_R, t_F	-	-	20	ns	Pin E
Address Setup Time	t_{SP1}	40	-	-	ns	Pins: RS, R/W, E
Address Hold Time	t_{HD1}	10	-	-	ns	Pins: RS, R/W, E
Data Setup Time	t_{SP2}	80	-	-	ns	Pins: DB0 - DB7
Data Hold Time	t_{HD2}	10	-	-	ns	Pins: DB0 - DB7

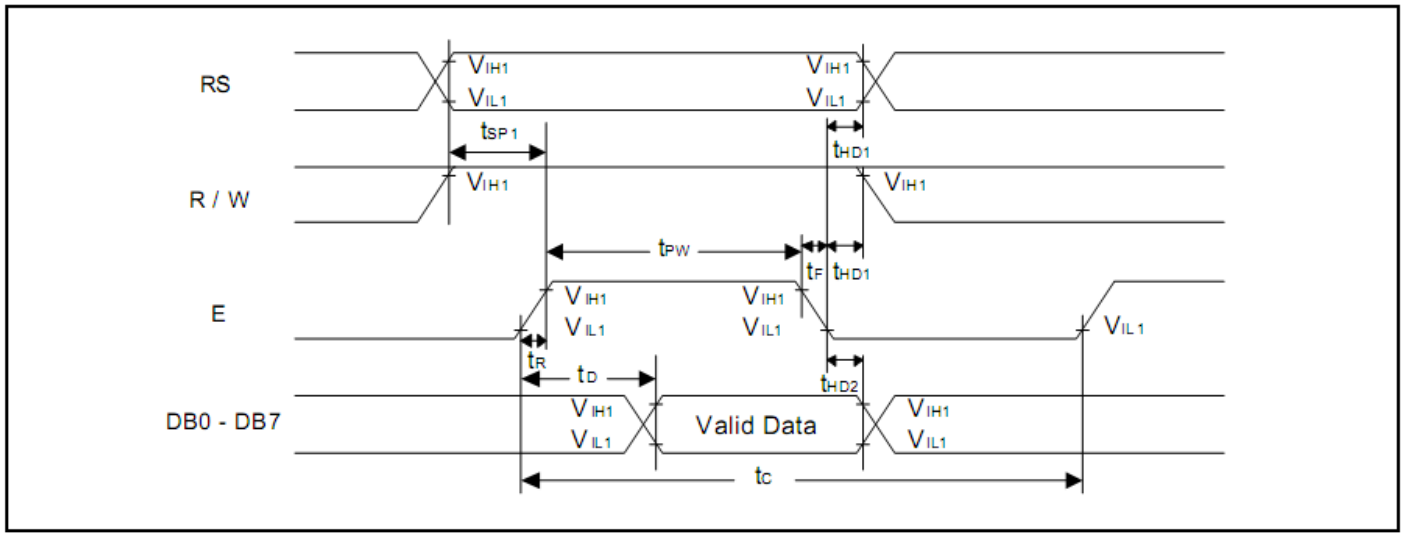
6.5.6. Write mode timing diagram (Writing Data from MPU to SPLC780D)



6.5.4. Read mode (Reading Data from SPLC780D to MPU)

Characteristics	Symbol	Limit			Unit	Test Condition
		Min.	Typ.	Max.		
E Cycle Time	t_C	500	-	-	ns	Pin E
E Pulse Width	t_W	230	-	-	ns	Pin E
E Rise/Fall Time	t_R, t_F	-	-	20	ns	Pin E
Address Setup Time	t_{SP1}	40	-	-	ns	Pins: RS, R/W, E
Address Hold Time	t_{HD1}	10	-	-	ns	Pins: RS, R/W, E
Data Output Delay Time	t_D	-	-	120	ns	Pins: DB0 - DB7
Data hold time	t_{HD2}	5.0	-	-	ns	Pin DB0 - DB7

6.5.7. Read mode timing diagram (Reading Data from SPLC780D to MPU)



Built-in Font Table

Example Initialization Program

```
4-bit Initialization:
/*********************************************************/
void command(char i)
{
      P1 = i;                       //put data on output Port
      D_I =0;                       //D/I=LOW : send instruction
      R_W =0;                       //R/W=LOW : Write
      Nybble();                     //Send lower 4 bits
      i = i<<4;                     //Shift over by 4 bits
      P1 = i;                       //put data on output Port
      Nybble();                     //Send upper 4 bits
}
/*********************************************************/
void write(char i)
{
      P1 = i;                       //put data on output Port
      D_I =1;                       //D/I=HIGH : send data
      R_W =0;                       //R/W=LOW : Write
      Nybble();                     //Clock lower 4 bits
      i = i<<4;                     //Shift over by 4 bits
      P1 = i;                       //put data on output Port
      Nybble();                     //Clock upper 4 bits
}
/*********************************************************/
void Nybble()
{
      E = 1;
      Delay(1);                     //enable pulse width  >= 300ns
      E = 0;                        //Clock enable: falling edge
}
/*********************************************************/
void init()
{
      P1 = 0;
      P3 = 0;
      Delay(100);                   //Wait >15 msec after power is applied
      P1 = 0x30;                    //put 0x30 on the output port
      Delay(30);                    //must wait 5ms, busy flag not available
      Nybble();                     //command 0x30 = Wake up
      Delay(10);                    //must wait 160us, busy flag not available
      Nybble();                     //command 0x30 = Wake up #2
      Delay(10);                    //must wait 160us, busy flag not available
      Nybble();                     //command 0x30 = Wake up #3
      Delay(10);                    //can check busy flag now instead of delay
      P1= 0x20;                     //put 0x20 on the output port
      Nybble();                     //Function set: 4-bit interface
      command(0x28);                //Function set: 4-bit/2-line
      command(0x10);                //Set cursor
      command(0x0F);                //Display ON; Blinking cursor
      command(0x06);                //Entry Mode set
}
/*********************************************************/
```

8-bit Initialization:

```
/*************************************************************/
void command(char i)
{
      P1 = i;                       //put data on output Port
      D_I =0;                       //D/I=LOW : send instruction
      R_W =0;                       //R/W=LOW : Write
      E  = 1;
      Delay(1);                     //enable pulse width  >= 300ns
        E  = 0;                     //Clock enable: falling edge
}
/*************************************************************/
void write(char i)
{
      P1 = i;                       //put data on output Port
      D_I =1;                       //D/I=LOW : send data
      R_W =0;                       //R/W=LOW : Write
      E  = 1;
      Delay(1);                     //enable pulse width  >= 300ns
      E  = 0;                       //Clock enable: falling edge
}
/*************************************************************/
void init()
{
      E = 0;
      Delay(100);                   //Wait >15 msec after power is applied
      command(0x30);                //command 0x30 = Wake up
      Delay(30);                    //must wait 5ms, busy flag not available
      command(0x30);                //command 0x30 = Wake up #2
      Delay(10);                    //must wait 160us, busy flag not available
      command(0x30);                //command 0x30 = Wake up #3
      Delay(10);                    //must wait 160us, busy flag not available
      command(0x38);                //Function set: 8-bit/2-line
      command(0x10);                //Set cursor
      command(0x0c);                //Display ON; Cursor ON
      command(0x06);                //Entry mode set
}
/*************************************************************/
```

Quality Information

Test Item	Content of Test	Test Condition	Note
High Temperature storage	Endurance test applying the high storage temperature for a long time.	+80°C , 48hrs	2
Low Temperature storage	Endurance test applying the low storage temperature for a long time.	-30°C , 48hrs	1,2
High Temperature Operation	Endurance test applying the electric stress (voltage & current) and the high thermal stress for a long time.	+70°C 48hrs	2
Low Temperature Operation	Endurance test applying the electric stress (voltage & current) and the low thermal stress for a long time.	-20°C , 48hrs	1,2
High Temperature / Humidity Operation	Endurance test applying the electric stress (voltage & current) and the high thermal with high humidity stress for a long time.	+40°C , 90% RH , 48hrs	1,2
Thermal Shock resistance	Endurance test applying the electric stress (voltage & current) during a cycle of low and high thermal stress.	0°C,30min -> +25°C,5min -> +50°C,30min = 1 cycle 10 cycles	
Vibration test	Endurance test applying vibration to simulate transportation and use.	10-55Hz , 15mm amplitude. 60 sec in each of 3 directions X,Y,Z For 15 minutes	3
Static electricity test	Endurance test applying electric static discharge.	VS=800V, RS=1.5kΩ, CS=100pF One time	

Note 1: No condensation to be observed.
Note 2: Conducted after 4 hours of storage at 25°C, 0%RH.
Note 3: Test performed on product itself, not inside a container.

Precautions for using 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