NHD-C12864WO-B1TFH#-M

COG (Chip-On-Glass) Liquid Crystal Display Module

NHD-	Newhaven Display
C12864-	128 x 64 Pixels
WO-	Display Type: COG
B1-	Model
T-	White LED Backlight
F-	FSTN Positive
H-	Transflective, Wide Temperature, 6:00 Optimal View
#-M-	Mounting Holes
	RoHS Compliant

Document Revision History

Revision	Date	Description	Changed by
0	9/1/08	Initial Release	-
1	11/12/09	User guide reformat	MC
2	12/14/09	Block Diagram Update	MC
3	2/12/10	Added –M to p/n to signify this part has mounting holes	MC
4	3/9/10	Block diagram updated	BE
5	5/4/10	Block diagram and pin description	MP
6	5/5/10	Backlight Connectors updated	BE
7	5/14/10	Pin description update	MP
8	5/2/11	Example initialization code updated	AK
9	5/13/11	Block diagram updated	AK
10	5/19/11	Block diagram & Pin description updated	AK
11	1/10/12	Pin description & Controller link updated	AK
12	6/15/12	Timing characteristics updated	AK
13	4/4/13	Backlight mating connector, LCD voltage levels updated	AK
14	4/15/13	Optical characteristics updated	AK
15	3/16/15	Pin description Updated	RM
16	12/30/16	Electrical Characteristics & Response Time Updated	SB
17	2/6/17	I_{LED} Updated	SB

Functions and Features

- **128 x 64 pixels**
- **Built-in ST7565P controller**
- **+3.3V power supply**
- **1/65 duty cycle; 1/9 bias**
- **RoHS Compliant**

Mechanical Drawing

Notes:

1. Driver: 1/65 Duty, 1/9 Bias
2. Resolution: 128x64 Pixels
3. Voltage: 3.0V VDD, 9.5V VLCD
4. Display Mode: FSTN Positive / Transflective
5. Optimal View: 6:00
6. Backlight: White LED
7. Driver IC: ST7565P

PIN NO.	SYMBOL	PIN NO.	SYMBOL	PIN NO.	SYMBOL
1	CS1B	11	D5	21	CAP2N
2	/RES	12	D6	22	V4
3	A0	13	D7	23	V3
4	/WR(R/W)	14	VDD	24	V2
5	/RD(E)	15	Vss	25	V1
6	D0	16	VOUT	26	V0
7	D1	17	CAP3P	27	VR
8	D2	18	CAP1N	28	C86
9	D3	19	CAP1P	29	P/S
10	D4	20	CAP2P	30	NC

Unit: mm

Gen. Tol.: ±0.3

Date: 12/30/16

NEWHAVEN DISPLAY INTERNATIONAL

Part Number: NHD-C12864WO-B1TFH#-M

Pin Description and Wiring Diagram

Pin No.	Symbol	External Connection	Function Description
1	/CS1	MPU	Active LOW chip select
2	/RES	MPU	Active LOW Reset signal
3	A0	MPU	Register select signal. 0: instruction; 1: data
4	R/W /WR	MPU	6800 Mode: Read/Write select signal. R/W=1: Read R/W: =0: Write 8080 Mode: Active LOW Write Signal
5	E /RD	MPU	6800 Mode: Active HIGH Enable Signal 8080 Mode: Active LOW Read Signal
6-13	DB0~DB7	MPU	In parallel interface: 8-bit-directional data bus In serial interface: DB0~DB5 = VDD or NC D6 = Serial clock D7 = Serial data
14	V_{DD}	Power Supply	Power supply for logic (+3V)
15	V_{SS}	Power Supply	Ground
16	V_{OUT}	Power Supply	1-4.7 µF cap to VSS
17	CAP3P	Power Supply	1-4.7 µF cap to CAP1N (pin-18)
18	CAP1N	Power Supply	1-4.7 µF cap to CAP3P (pin-17) and CAP1P (pin-19)
19	CAP1P	Power Supply	1-4.7 µF cap to CAP1N (pin-18)
20	CAP2P	Power Supply	1-4.7 µF cap to CAP2N (pin-21)
21	CAP2N	Power Supply	1-4.7 µF cap to CAP2P (pin-20)
22-26	V_4~V_0	Power Supply	0.1-4.7 µF cap to VDD or VSS
27	V_R	Adj. Power Supply	Wiper of 10kΩ pot (see schematic below)
28	C86	MPU	Select MPU interface pin. C86= H:6800; C86= L:8080
29	P/S	MPU	Parallel/Serial select. PS= H: Parallel; PS= L: Serial
30	NC	-	No connect

Recommended LCD connector: 0.5mm Pitch, 30 pin FFC. Molex p/n: 52892-3095
Backlight connector: A2001H-02P   **Mates with**: A2001WR-2P, A2001WR-S-2P, A2001WV-2P, A2001WV-S-2P
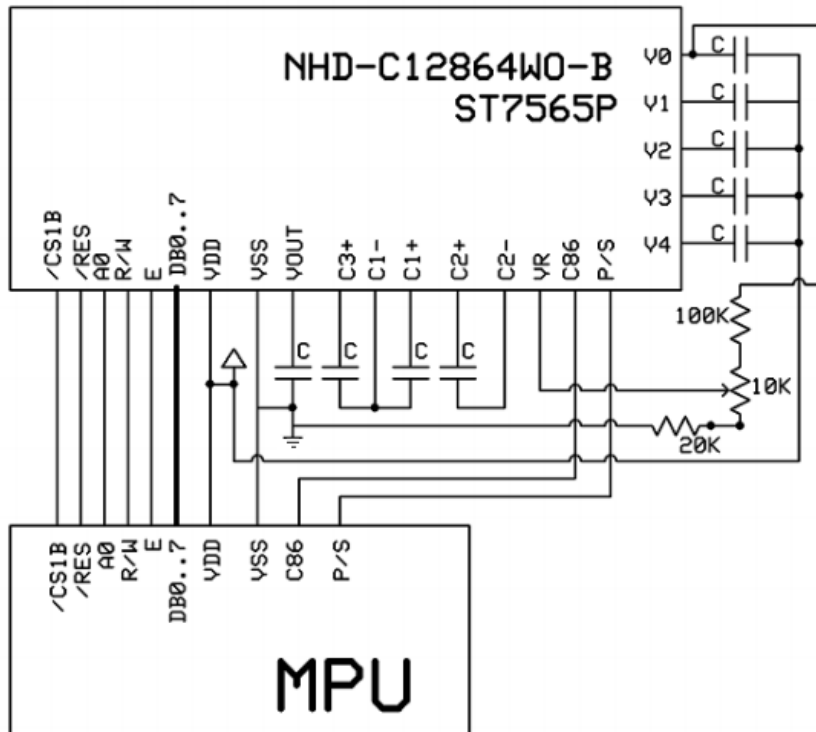
Electrical Characteristics

Item	Symbol	Condition	Min.	Typ.	Max.	Unit
Operating Temperature Range	T_{OP}	Absolute Max	-20	-	+70	ºC
Storage Temperature Range	T_{ST}	Absolute Max	-30	-	+80	ºC
Supply Voltage	V_{DD}	-	2.7	3.0	3.3	V
Supply Current	I_{DD}	V_{DD} = 3.0V	0.2	0.6	2.0	mA
Supply for LCD (contrast)	V_{LCD}	T_{OP} = 25°C	9.2	9.5	9.8	V
"H" Level input	V_{IH}	-	$0.8 * V_{DD}$	-	V_{DD}	V
"L" Level input	V_{IL}	-	V_{SS}	-	$0.2 * V_{DD}$	V
"H" Level output	V_{OH}	-	$0.8 * V_{DD}$	-	V_{DD}	V
"L" Level output	V_{OL}	-	V_{SS}	-	$0.2 * V_{DD}$	V
LED Backlight voltage	V_{LED}	-	3.4	3.5	3.6	V
LED Backlight current	I_{LED}	V_{LED} =3.5V	30	65	80	mA

Optical Characteristics

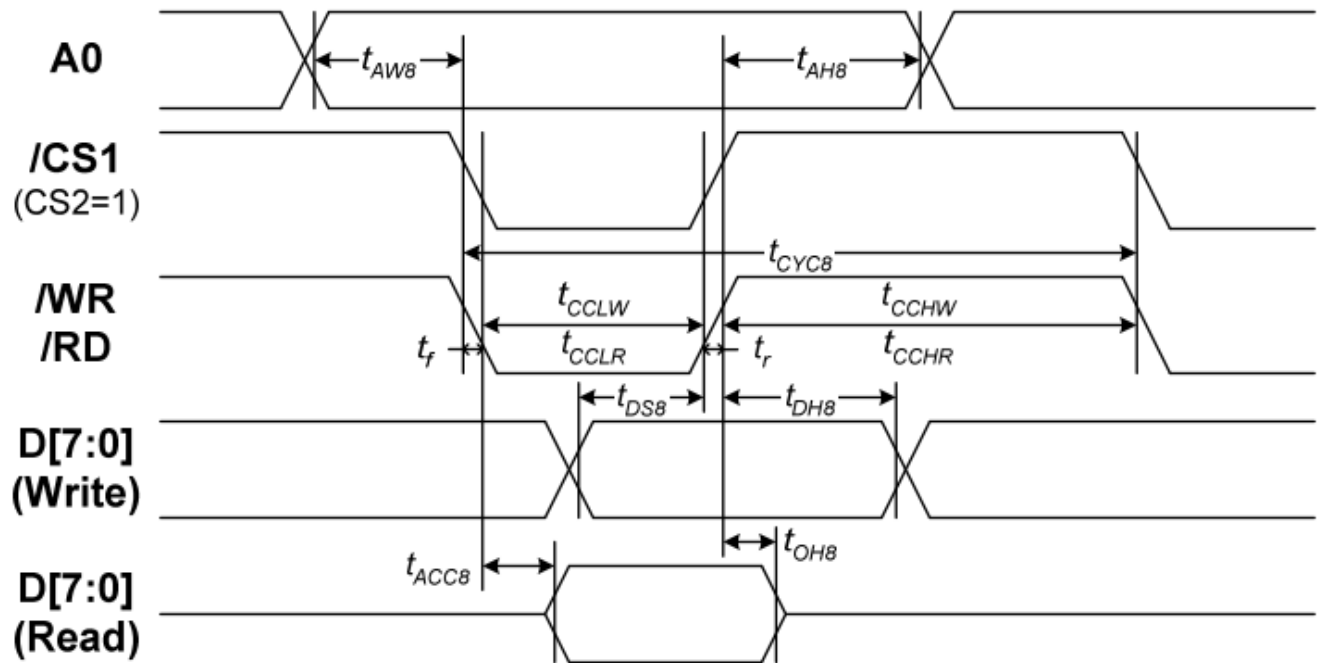| Item		Symbol	Condition	Min.	Typ.	Max.	Unit
Optimal Viewing Angles	Top	φY+		-	30	-	°
	Bottom	φY-	CR ≥ 2	-	60	-	°
	Left	θX-		-	45		°
	Right	θX+		-	45	-	°
Contrast Ratio		CR	-	2	5	-	-
Response Time	Rise	T_R	T_{OP} = 25°C	-	200	300	ms
	Fall	T_F		-	250	350	ms

Controller Information

Built-in ST7565P controller
Please download specification at http://www.newhavendisplay.com/app_notes/ST7565P.pdf

Timing Characteristics

System Bus Read/Write Characteristics 1 (For the 8080 Series MPU)

(V_{DD} = 3.3V, Ta = −30 to 85℃)

$(V_{DD} = 3.3V, Ta = -30$ to $85℃)$

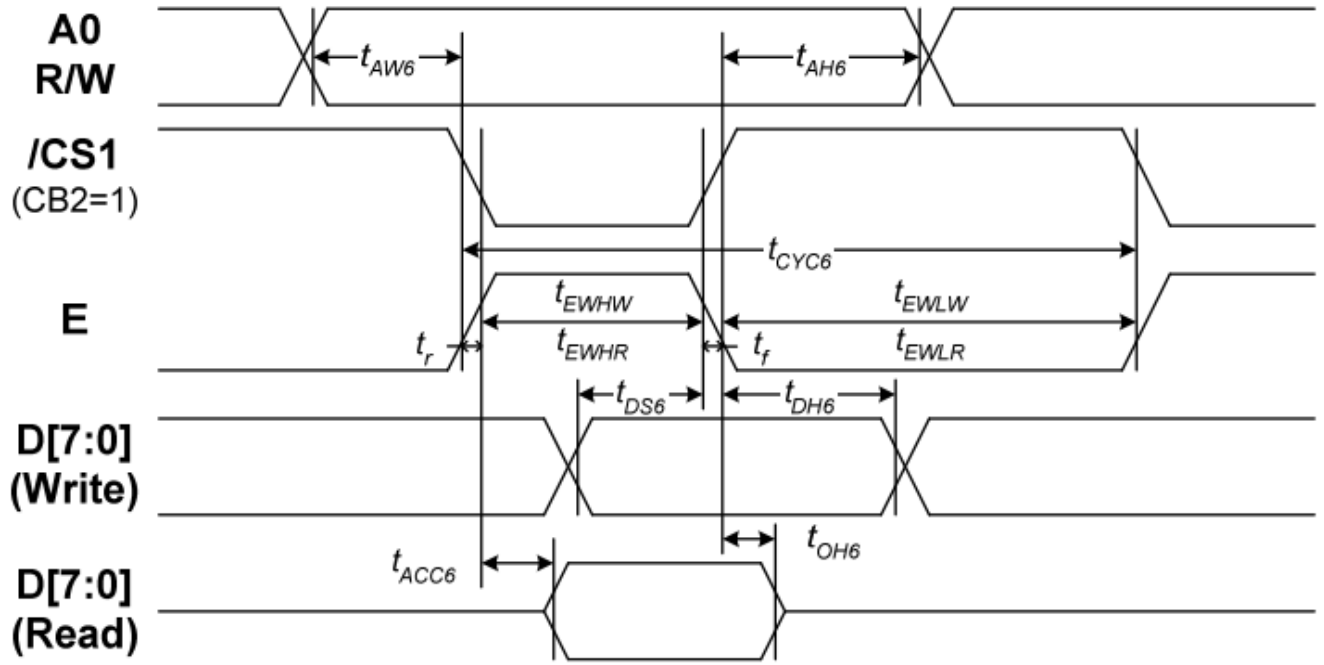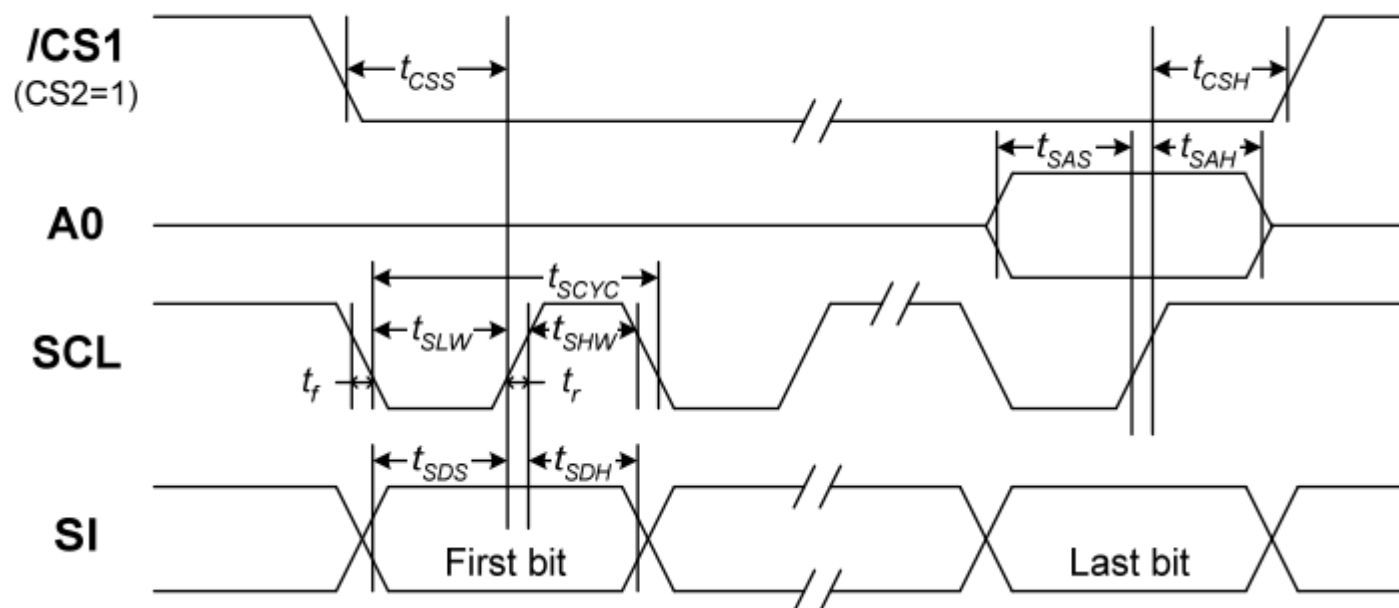| Item	Signal	Symbol	Condition	Rating Min.	Rating Max.	Units
Address hold time	A0	t_{AH8}		0	—	
Address setup time		t_{AW8}		0	—	
System cycle time		t_{CYC8}		240	—	
Write L pulse width	/WR	t_{CCLW}		80	—	
Write H pulse width		t_{CCHW}		80	—	
Read L pulse width	/RD	t_{CCLR}		140	—	Ns
Read H pulse width		t_{CCHR}		80	—	
Write Data setup time	D0 to D7	t_{DS8}		40	—	
Write Address hold time		t_{DH8}		0	—	
Read access time		t_{ACC8}	$C_L = 100$ pF	—	70	
Read Output disable time		t_{OH8}	$C_L = 100$ pF	5	50	

System Bus Read/Write Characteristics 2 (For the 6800 Series MPU)

(VDD = 3.3V, Ta = –30 to 85℃)

Item	Signal	Symbol	Condition	Rating Min.	Rating Max.	Units
Address hold time	A0	tAH6		0	—	
Address setup time		tAW6		0	—	
System cycle time		tCYC6		240	—	
Enable L pulse width (WRITE)	E	tEWLW		80	—	
Enable H pulse width (WRITE)		tEWHW		80	—	
Enable L pulse width (READ)		tEWLR		80	—	ns
Enable H pulse width (READ)		tEWHR		140		
WRITE Data setup time	D0 to D7	tDS6		40	—	
WRITE Address hold time		tDH6		0	—	
READ access time		tACC6	CL = 100 pF	—	70	
READ Output disable time		tOH6	CL = 100 pF	5	50	

[7]

The Serial Interface

(VDD = 3.3V, Ta = −30 to 85℃)

Item	Signal	Symbol	Condition	Rating		Units
				Min.	Max.	
Serial Clock Period		t_{SCYC}		50	—	
SCL "H" pulse width	SCL	t_{SHW}		25	—	
SCL "L" pulse width		t_{SLW}		25	—	
Address setup time	A0	t_{SAS}		20	—	
Address hold time		t_{SAH}		10	—	ns
Data setup time	SI	t_{SDS}		20	—	
Data hold time		t_{SDH}		10	—	
CS-SCL time	CS	t_{CSS}		20	—	
CS-SCL time		t_{CSH}		40	—	

Table of Commands

Command	A0	/RD	/WR	D7	D6	D5	D4	D3	D2	D1	D0	Function
				Command Code								**Function**
(1) Display ON/OFF	0	1	0	1	0	1	0	1	1	1	0 1	LCD display ON/OFF 0: OFF, 1: ON
(2) Display start line set	0	1	0	0	1	Display start address						Sets the display RAM display start line address
(3) Page address set	0	1	0	1	0	1	1	Page address				Sets the display RAM page address
(4) Column address set upper bit	0	1	0	0	0	0	1	Most significant column address				Sets the most significant 4 bits of the display RAM column address.
Column address set lower bit	0	1	0	0	0	0	0	Least significant column address				Sets the least significant 4 bits of the display RAM column address.
(5) Status read	0	0	1	Status				0	0	0	0	Reads the status data
(6) Display data write	1	1	0	Write data								Writes to the display RAM
(7) Display data read	1	0	1	Read data								Reads from the display RAM
(8) ADC select	0	1	0	1	0	1	0	0	0	0	0 1	Sets the display RAM address SEG output correspondence 0: normal, 1: reverse
(9) Display normal/reverse	0	1	0	1	0	1	0	0	1	1	0 1	Sets the LCD display normal/reverse 0: normal, 1: reverse
(10) Display all points ON/OFF	0	1	0	1	0	1	0	0	1	0	0 1	Display all points 0: normal display 1: all points ON
(11) LCD bias set	0	1	0	1	0	1	0	0	0	1	0 1	Sets the LCD drive voltage bias ratio 0: 1/9 bias, 1: 1/7 bias (ST7565)
(12) Read/modify/write	0	1	0	1	1	1	0	0	0	0	0	Column address increment At write: +1 At read: 0
(13) End	0	1	0	1	1	1	0	1	1	1	0	Clear read/modify/write
(14) Reset	0	1	0	1	1	1	0	0	0	1	0	Internal reset
(15) Common output mode select	0	1	0	1	1	0	0	0 1	*	*	*	Select COM output scan direction 0: normal direction 1: reverse direction
(16) Power control set	0	1	0	0	0	1	0	1	Operating mode			Select internal power supply operating mode
(17) V5 voltage regulator internal resistor ratio set	0	1	0	0	0	1	0	0	Resistor ratio			Select internal resistor ratio(Rb/Ra) mode
(18) Electronic volume mode set	0	1	0	1	0	0	0	0	0	0	1	Set the V5 output voltage electronic volume register
Electronic volume register set				0	0	Electronic volume value						
(19) Static indicator ON/OFF	0	1	0	1	0	1	0	1	1	0	0 1	0: OFF, 1: ON
Static indicator register set				0	0	0	0	0	0	Mode		Set the flashing mode
(20) Power saver												Display OFF and display all points ON compound command
(21) NOP	0	1	0	1	1	1	0	0	0	1	1	Command for non-operation
(22) Test	0	1	0	1	1	1	1	*	*	*	*	Command for IC test. Do not use this command

Example Initialization Program

```
/*********************************************************************/
void comm_out(unsigned int c)
{
        CS1 = 0;  //Active Low
        AO = 0;   //LOW = instruction
        delay(1);
        WRT = 0;   // /WR in 8080 mode; R/W in 6800 mode
        P1 = c;
        delay(1);
        WRT = 1;   // /WR in 8080 mode; R/W in 6800 mode
        CS1 = 1;  //inactive
}

void data_out(unsigned int d)
{
        CS1 = 0;  //Active Low
        AO = 1;   //High = Data
        delay(1);
        WRT = 0;
        P1 = d;
        delay(1);
        WRT = 1;
        CS1 = 1;  //inactive
}

void init()
{
        //IRS pin is tied low internally - external resistor circuit must be used
        C86 = 1;                // Interface set to 8080 mode
        RDD = 1;                // /RD in 8080 mode; E in 6800 mode
        WRT = 1;                // /WR in 8080 mode; R/W in 6800 mode
        CS1 = 0;
        RST = 1;                // /RST in 8080 mode; /RES in 6800 mode
        RST = 0;                // /RST in 8080 mode; /RES in 6800 mode
        delay(2);
        RST = 1;                // /RST in 8080 mode; /RES in 6800 mode
        delay(2);
        comm_out(0xA2);         //added 1/9 bias
        comm_out(0xA0);         //ADC segment driver direction (A0=Normal)
        comm_out(0xC8);
        comm_out(0xC0);         //COM output scan direction (C0= Normal)
        comm_out(0x40);         //Operating Mode
        comm_out(0x25);         //resistor ratio
        comm_out(0x19);         //column address set upper bit
        comm_out(0x2F);          //select internal resistor ratio
        comm_out(0xAF);         //display ON/OFF - set to ON
}
/*********************************************************************/
```

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 , 200hrs	2
Low Temperature storage	Endurance test applying the low storage temperature for a long time.	-30°C , 200hrs	1,2
High Temperature Operation	Endurance test applying the electric stress (voltage & current) and the high thermal stress for a long time.	+70°C 200hrs	2
Low Temperature Operation	Endurance test applying the electric stress (voltage & current) and the low thermal stress for a long time.	-20°C , 200hrs	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.	+60°C , 90% RH , 96hrs	1,2
Thermal Shock resistance	Endurance test applying the electric stress (voltage & current) during a cycle of low and high thermal stress.	-20°C,30min -> 25°C,5min -> 70°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.	V_S=800V, R_S=330Ω, C_S=150pF 10 Times	

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

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