NHD-C128128BZ-FSW-GBW

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

NHD-	Newhaven Display
C128128-	128 x 128 Pixels
BZ-	Model
F-	Transflective
SW-	Side White LED Backlight
G-	STN-Gray
B-	6:00 Optimal View
W-	Wide Temp
	RoHS Compliant

Newhaven Display International, Inc.

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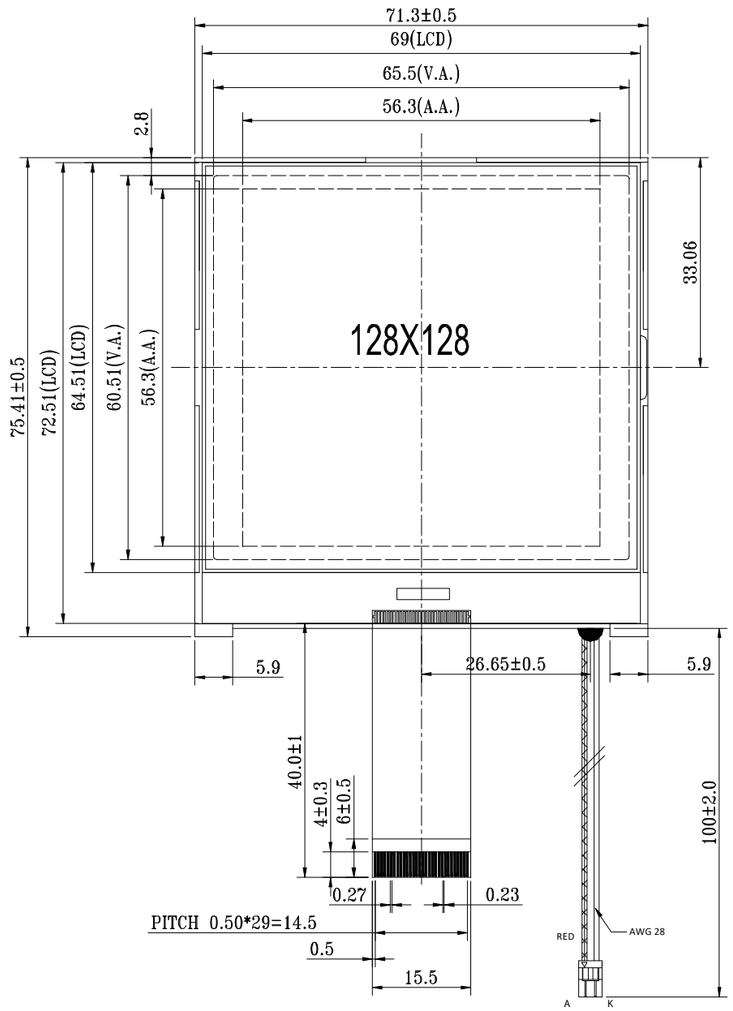
Document Revision History

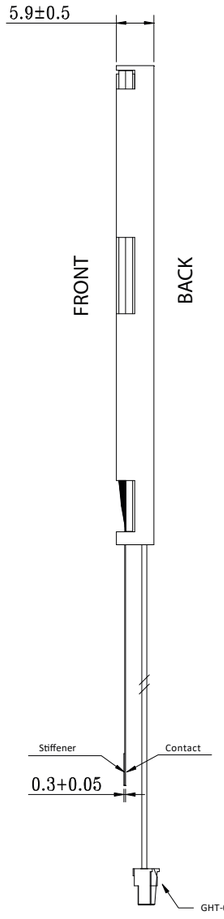
Revision	Date	Description	Changed by
0	6/17/2007	Initial Release	-
1	9/23/2009	User guide reformat	BE
2	10/14/2009	Updated Electrical Characteristic	MC
3	11/20/2009	Updated backlight supply current	MC
4	3/4/2011	Updated table of commands	AK
5	8/25/16	Mechanical Drawing, Electrical & Optical Char. Updated	SB
6	4/27/18	Mechanical Drawing & Electrical Characteristics Updated	SB
7	1/16/20	Updated LCD Panel	SB

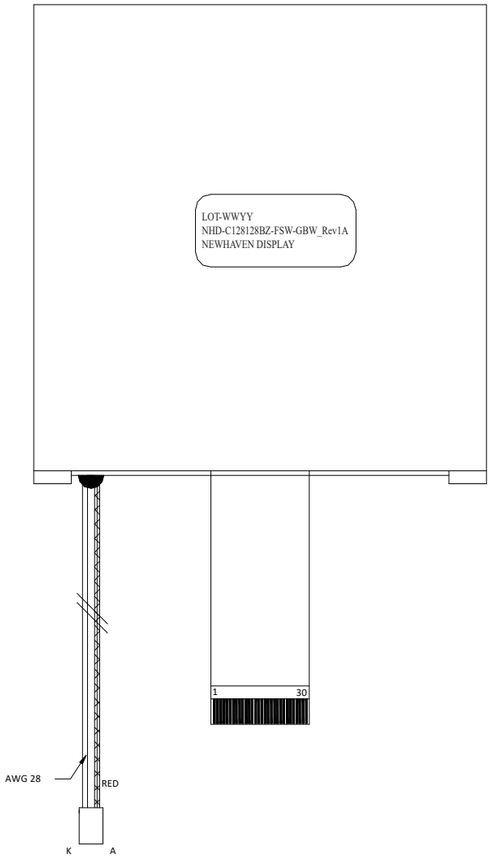
Functions and Features

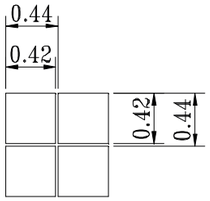
- **128 x 128 pixels**
- **Built-in ST7528 controller**
- **+3.0V power supply**
- **1/128 duty cycle; 1/12 bias**
- **RoHS Compliant**

SYMBOL	REVISION	DATE



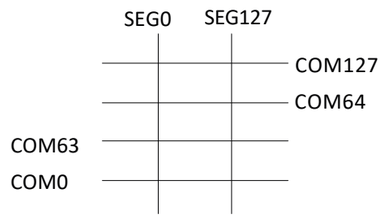






PIN ASSIGNMENT

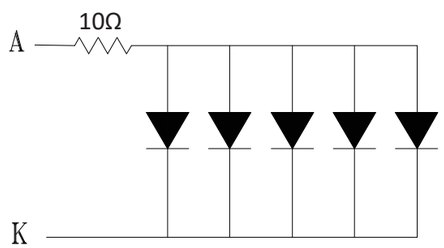
NO.	SIGNAL
1	PS0
2	PS1
3	PS2
4	CSB
5	RST
6	A0
7	RW-WR
8	E-RD
9	DB0
10	DB1
11	DB2
12	DB3
13	DB4
14	DB5
15	DB6
16	DB7
17	VDD
18	VDD
19	VSS
20	VSS
21	VOUT-OUT
22	VOUT-IN
23	V4
24	V3
25	V2
26	V1
27	V0
28	VR
29	INTRS
30	NC



COM & SEG LAYOUT

Notes:

1. Driver:	1/128 Duty, 1/12 Bias
2. Display Mode:	STN Positive / Gray / Transflective
3. Optimal View:	6:00
4. Voltage:	3.0V VDD, 13.6V VLCD
5. Backlight:	White LED
6. Driver IC:	ST7528



STANDARD TOLERANCE:
(UNLESS OTHERWISE SPECIFIED)

LINEAR: ±0.3mm

UNLESS OTHERWISE SPECIFIED:
- DIMENSIONS ARE IN MILLIMETERS
- THIRD ANGLE PROJECTION

NEWHAVEN DISPLAY INTERNATIONAL

DRAWING/PART NUMBER: NHD-C128128BZ-FSW-GBW

REVISION: 1A

SIZE: A3

SCALE: NS

DRAWN BY: S. Baxi

APPROVED BY: S. Baxi

DRAWN DATE: 1/16/20

APPROVED DATE: 1/16/20

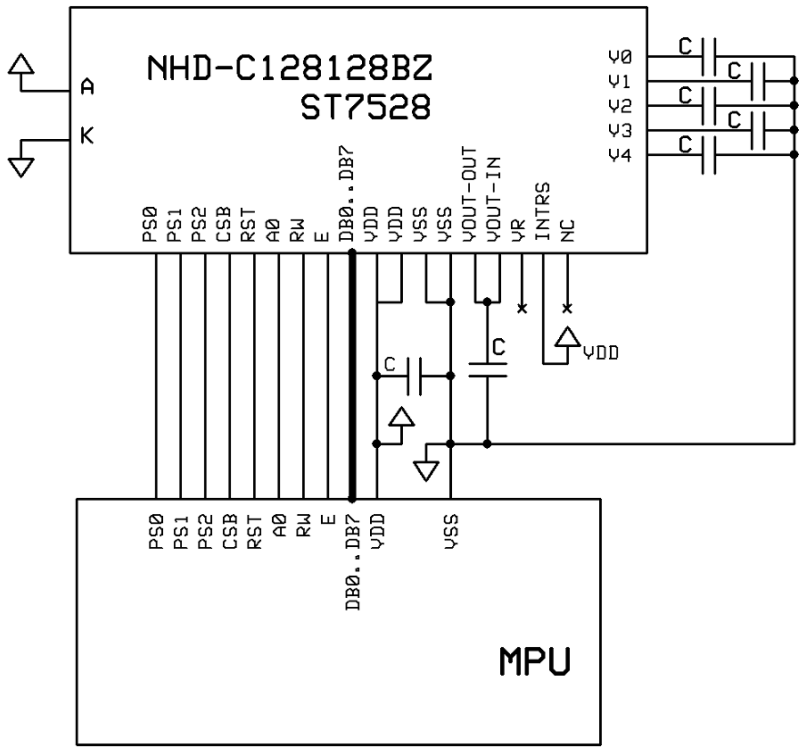
DO NOT SCALE DRAWING

SHEET 1 OF 1

Pin Description and Wiring Diagram

Pin No.	Symbol	External Connection	Function Description
1	PS0	Input	Parallel/serial data input select input (see Parallel/Serial Select table)
2	PS1	Input	
3	PS2	Input	IIC not available (tie low)
4	CSB	MPU	Active LOW Chip select
5	RST	MPU	Active LOW Reset signal
6	A0	MPU	Register select signal. A0=1: Data, A0=0: Command
7	R/W /WR	MPU	6800 Mode: Read/Write select signal. R/W=1: Read R/W: =0: Write 8080 Mode: Active LOW Write Signal
8	E /RD	MPU	6800 Mode: Active HIGH Enable Signal 8080 Mode: Active LOW Read Signal
9-16	DB0-DB7	MPU	Bi-directional, three-state data bus lines
17,18	V_{DD}	Power Supply	Supply Voltage for logic (3.0V)
19,20	V_{SS}	Power Supply	Ground
21	V_{OUT}	Power Supply	Voltage booster circuit – connect to 1uF cap to V_{SS} or V_{DD}
22	V_{IN}	Power Supply	Tie to V_{OUT}
23	V_4	Power Supply	1.0uF-2.2uF cap to VSS
24	V_3	Power Supply	1.0uF-2.2uF cap to VSS
25	V_2	Power Supply	1.0uF-2.2uF cap to VSS
26	V_1	Power Supply	1.0uF-2.2uF cap to VSS
27	V_0	Power Supply	1.0uF-2.2uF cap to VSS
28	V_R	-	No Connect
29	INTRS	Input	Internal resistor select pin: V_{DD}=Enabled
30	NC	-	No Connect

Recommended LCD connector: 0.5mm pitch, 30 pin FFC. Molex p/n: 52892-3095
Backlight connector: GHR-02V-S **Mates with**: BM02B-GHS-T



Parallel/Serial Select Table

PS2	PS1	PS0	Interface mode	Data/ Command	Data	Read/ Write	Serial clock
L	L	H	Parallel 80	A0	DB0 to DB7	RD/WR	-
L	H	H	Parallel 68	A0	DB0 to DB7	E/RW	-
L	L	L	3Line Serial	-	SID (DB7)	Write only	SCLK (DB6)
L	H	L	4Line Serial	A0	SID (DB7)	Write only	SCLK (DB6)

*Cannot read data from RAM in 4-line, 3-line, or IIC interface.
*In 4-line or 3-line interface, DB0-DB5, E, and RW must be tied High or Low
*In IIC or 3-line interface, A0 must be tied High or Low

Electrical Characteristics

Item	Symbol	Condition	Min.	Typ.	Max.	Unit
Operating Temperature Range	T_{OP}	Absolute Max	-20	-	+70	°C
Storage Temperature Range	T_{ST}	Absolute Max	-30	-	+80	°C
Supply Voltage	V_{DD}	-	2.7	3.0	3.3	V
Supply Current	I_{DD}	V_{DD} = 3.0V	0.5	1.0	1.5	mA
Supply for LCD (contrast)	V_{LCD}	T_{OP} = 25°C	13.3	13.6	13.9	V
"H" Level input	V_{IH}	-	2.2	-	V_{DD}	V
"L" Level input	V_{IL}	-	V_{SS}	-	0.6	V
"H" Level output	V_{OH}	-	2.4	-	V_{DD}	V
"L" Level output	V_{OL}	-	V_{SS}	-	0.4	V
Backlight supply voltage	V_{LED}	-	3.0	3.3	3.5	V
Backlight supply current	I_{LED}	V_{LED} = 3.3V	30	45	60	mA

Optical Characteristics

Item		Symbol	Condition	Min.	Typ.	Max.	Unit
Optimal Viewing Angles	Top	φY+	CR ≥ 2	-	35	-	º
	Bottom	φY-		-	60	-	º
	Left	θX-		-	60	-	º
	Right	θX+		-	60	-	º
Contrast Ratio		CR	-	2	6	-	-
Response Time	Rise	T_R	T_{OP} = 25°C	-	150	250	ms
	Fall	T_F		-	200	300	ms

Controller Information

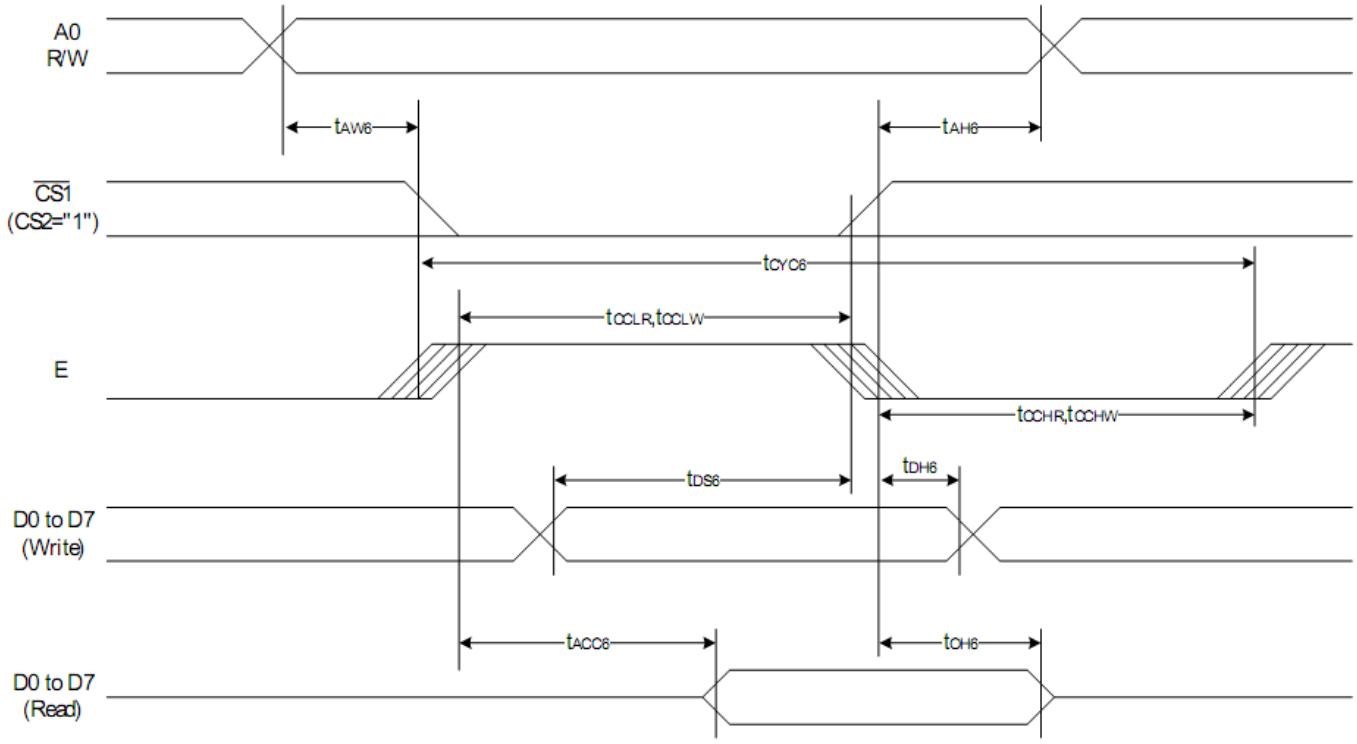
Built-in ST7528 controller.
Please download specification at http://www.newhavendisplay.com/app_notes/ST7528.pdf

Table of Commands

Instruction	A0	RW	DB7	DB6	DB5	DB4	DB3	DB2	DB1	DB0	Description
EXT=0 or 1											
Mode Set	0	0	0	0	1	1	1	0	0	0	2-byte instruction to set Mode and FR(Frame frequency control) BE(Booster efficiency control)
	0	0	FR3	FR2	FR1	FR0	0	BE	x'	EXT	
EXT=0											
Read display data	1	1	Read data								Read data into DDRAM
Write display data	1	0	Write data								Write data into DDRAM
Read status	0	1	BUSY	ON	RES	MF2	MF1	MF0	DS1	DS0	Read the internal status
ICON control register ON/OFF	0	0	1	0	1	0	0	0	1	ICON	ICON=0: ICON disable(default) ICON=1: ICON enable & set the page address to 16
Set page address	0	0	1	0	1	1	P3	P2	P1	P0	Set page address
Set column address MSB	0	0	0	0	0	1	Y9	Y8	Y7	Y6	Set column address MSB
Set column address LSB	0	0	0	0	0	0	Y5	Y4	Y3	Y2	Set column address LSB
Set modify-read	0	0	1	1	1	0	0	0	0	0	Set modify-read mode
Reset modify-read	0	0	1	1	1	0	1	1	1	0	release modify-read mode
Display ON/OFF	0	0	1	0	1	0	1	1	1	D	D=0: Display OFF D=1: Display ON
Set initial display line register	0	0	0	1	0	0	0	0	x'	x'	2-byte instruction to specify the initial display line to realize vertical scrolling
	0	0	x'	S6	S5	S4	S3	S2	S1	S0	
Set initial COM0 register	0	0	0	1	0	0	0	1	x'	x'	2-byte instruction to specify the initial COM0 to realize window scrolling
	0	0	x'	C6	C5	C4	C3	C2	C1	C0	
Set partial display duty ration	0	0	0	1	0	0	1	0	x'	x'	2-byte instruction to set partial display duty ratio
	0	0	D7	D6	D5	D4	D3	D2	D1	D0	
Set N-line inversion	0	0	0	1	0	0	1	1	x'	x'	2-byte instruction to set N-line inversion register
	0	0	x'	x'	x'	N4	N3	N2	N1	N0	
Release N-line inversion	0	0	1	1	1	0	0	1	0	0	Release N-line inversion mode
Reverse display ON/OFF	0	0	1	0	1	0	0	1	1	REV	REV=0: normal display REV=1: reverse display
Entire display ON/OFF	0	0	1	0	1	0	0	1	0	EON	EON=0: normal display EON=1: entire display ON

Instruction	A0	RW	DB7	DB6	DB5	DB4	DB3	DB2	DB1	DB0	Description
Ext=0											
Power control	0	0	0	0	1	0	1	VC	VR	VF	Control power circuit operation
Select DC-DC step-up	0	0	0	1	1	0	0	1	DC1	DC0	Select the step-up of internal voltage converter
Select regulator register	0	0	0	0	1	0	0	R2	R1	R0	Select the internal resistance ratio of the regulator resistor
Select electronic volumn register	0	0	1	0	0	0	0	0	0	1	2-byte instruction to specify the reference voltage
	0	0	x'	x'	EV5	EV4	EV3	EV2	EV1	EV0	
Select LCD bias	0	0	0	1	0	1	0	B2	B1	B0	Select LCD bias
Bias Power Save	0	0	1	1	1	1	0	0	1	1	Bias Power save Save the Bias current consumption
	0	0	0	0	0	0	0	0	0	0	
SHL select	0	0	1	1	0	0	SHL	x'	x'	x'	COM bi-directional selection SHL=0: normal direction SHL=1: reverse direction
ADC select	0	0	1	0	1	0	0	0	0	ADC	SEG bi-direction selection ADC=0: normal direction ADC=1: reverse direction
Oscillator on start	0	0	1	0	1	0	1	0	1	1	Start the built-in oscillator
Set power save mode	0	0	1	0	1	0	1	0	0	P	P=0: normal mode P=1: sleep mode
Release power save mode	0	0	1	1	1	0	0	0	0	1	release power save mode
Reset	0	0	1	1	1	0	0	0	1	0	initial the internal function
Set data direction & display data length(DDL)	x'	x'	1	1	1	0	1	0	0	0	2-byte instruction to specify the number of data bytes. (SPI mode)
	x'	x'	D7	D6	D5	D4	D3	D2	D1	D0	
Select FRC and PWM mode	0	0	1	0	0	1	0	FRC	PWM1	PWM0	FRC(1:3FRC, 0:4FRC) PWM1 PWM0 0 0 45PWM 0 1 45 PWM 1 0 60PWM 1 1 ---
NOP	0	0	1	1	1	0	0	0	1	1	*No operation*
Test Instruction	0	0	1	1	1	1	x'	x'	x'	x'	*Don't use this instruction*

Timing Characteristics



Item	Signal	Symbol	Condition	Rating		Units
				Min.	Max.	
Address hold time	A0	tAH6		0	—	ns
Address setup time		tAW6		0	—	
System cycle time		tCYC6		240	—	
Enable L pulse width (WRITE)	WR	tEWLW		80	—	
Enable H pulse width (WRITE)		tEWHW		80	—	
Enable L pulse width (READ)	RD	tEWLR		80	—	
Enable H pulse width (READ)		tEWHR		140		
WRITE Data setup time	D0 to D7	tDS6		40	—	
WRITE Data hold time		tDH6		10	—	
READ access time		tACC6	CL = 100 pF	—	70	
READ Output disable time		tOH6	CL = 100 pF	5	50	

Example Initialization Program

```
/*************************************************************/
/*************************************************************/
void write_command(unsigned char datum)
{
 A0=0;                                          /*Instruction register*/
 E=1;                                           /*Read inactive*/
 bus=datum;                                     /*put data on port 1*/
 CSB=0;                                         /*Chip select active*/
 RW=0;                                          /*Write active*/
 RW=1;                                          /*Write inactive; latch in data*/
 CSB=1;                                         /*Chip select inactive*/
}
/*************************************************************/
void write_data(unsigned char datum)
{
 A0=1;                                          /*DDRAM data register*/
 E=1;
 bus=datum;
 CSB=0;
 RW=0;
 RW=1;
 CSB=1;
}
/*************************************************************/
void lcd_init(void){
      write_command(0xA2);      //ICON  OFF;
      write_command(0xAE);      //Display OFF

      write_command(0x48);      //Set Duty ratio
      write_command(0x80);      //No operation
      write_command(0xa0);      //Set scan direction
      write_command(0xc8);      //SHL  select
      write_command(0x40);      //Set START LINE
      write_command(0x00);
      write_command(0xab);      //OSC on

      write_command(0x64);      //3x
      delay(2000);
      write_command(0x65);      //4x
      delay(2000);
      write_command(0x66);      //5x
      delay(2000);
      write_command(0x67);      //6x
      delay(2000);

      write_command(Ra_Rb);      //RESISTER SET
      write_command(0x81);      //Set electronic volume register
      write_command(vopcode);    //n=0~3f


      write_command(0x57);      //1/12bias
      write_command(0x92);      //FRC and pwm


      write_command(0x2C);
      delay(20000);//200ms
      write_command(0x2E);
      delay(20000);//200ms
      write_command(0x2F);
      delay(20000);//200ms
```

```
write_command(0x92);      //frc and pwm
write_command(0x38);      //external  mode
write_command(0x75);

      /*** start settings for 16-level grayscale ***/

write_command(0x97);      //3frc,45pwm

write_command(0x80);
write_command(0x00);
write_command(0x81);
write_command(0x00);
write_command(0x82);
write_command(0x00);
write_command(0x83);
write_command(0x00);

write_command(0x84);
write_command(0x06);
write_command(0x85);
write_command(0x06);
write_command(0x86);
write_command(0x06);
write_command(0x87);
write_command(0x06);

write_command(0x88);
write_command(0x0b);
write_command(0x89);
write_command(0x0b);
write_command(0x8a);
write_command(0x0b);
write_command(0x8b);
write_command(0x0b);

write_command(0x8c);
write_command(0x10);
write_command(0x8d);
write_command(0x10);
write_command(0x8e);
write_command(0x10);
write_command(0x8f);
write_command(0x10);

write_command(0x90);
write_command(0x15);
write_command(0x91);
write_command(0x15);
write_command(0x92);
write_command(0x15);
write_command(0x93);
write_command(0x15);

write_command(0x94);
write_command(0x1a);
write_command(0x95);
write_command(0x1a);
write_command(0x96);
write_command(0x1a);
write_command(0x97);
write_command(0x1a);

write_command(0x98);
```

```
write_command(0x1e);
write_command(0x99);
write_command(0x1e);
write_command(0x9a);
write_command(0x1e);
write_command(0x9b);
write_command(0x1e);

write_command(0x9c);
write_command(0x23);
write_command(0x9d);
write_command(0x23);
write_command(0x9e);
write_command(0x23);
write_command(0x9f);
write_command(0x23);

write_command(0xa0);
write_command(0x27);
write_command(0xa1);
write_command(0x27);
write_command(0xa2);
write_command(0x27);
write_command(0xa3);
write_command(0x27);

write_command(0xa4);
write_command(0x2b);
write_command(0xa5);
write_command(0x2b);
write_command(0xa6);
write_command(0x2b);
write_command(0xa7);
write_command(0x2b);

write_command(0xa8);
write_command(0x2f);
write_command(0xa9);
write_command(0x2f);
write_command(0xaa);
write_command(0x2f);
write_command(0xab);
write_command(0x2f);

write_command(0xac);
write_command(0x32);
write_command(0xad);
write_command(0x32);
write_command(0xae);
write_command(0x32);
write_command(0xaf);
write_command(0x32);

write_command(0xb0);
write_command(0x35);
write_command(0xb1);
write_command(0x35);
write_command(0xb2);
write_command(0x35);
write_command(0xb3);
write_command(0x35);
```

```
    write_command(0xb4);
    write_command(0x38);
    write_command(0xb5);
    write_command(0x38);
    write_command(0xb6);
    write_command(0x38);
    write_command(0xb7);
    write_command(0x38);

    write_command(0xb8);
    write_command(0x3a);
    write_command(0xb9);
    write_command(0x3a);
    write_command(0xba);
    write_command(0x3a);
    write_command(0xbb);
    write_command(0x3a);

    write_command(0xbc);
    write_command(0x3c);
    write_command(0xbd);
    write_command(0x3c);
    write_command(0xbe);
    write_command(0x3c);
    write_command(0xbf);
    write_command(0x3c);
        //end settings for 16-level grayscale
    write_command(0x38);
    write_command(0x74);
    write_command(0xaf);    //Display 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, 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