

# 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
	<b>RoHS Compliant</b>

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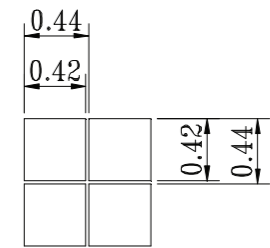
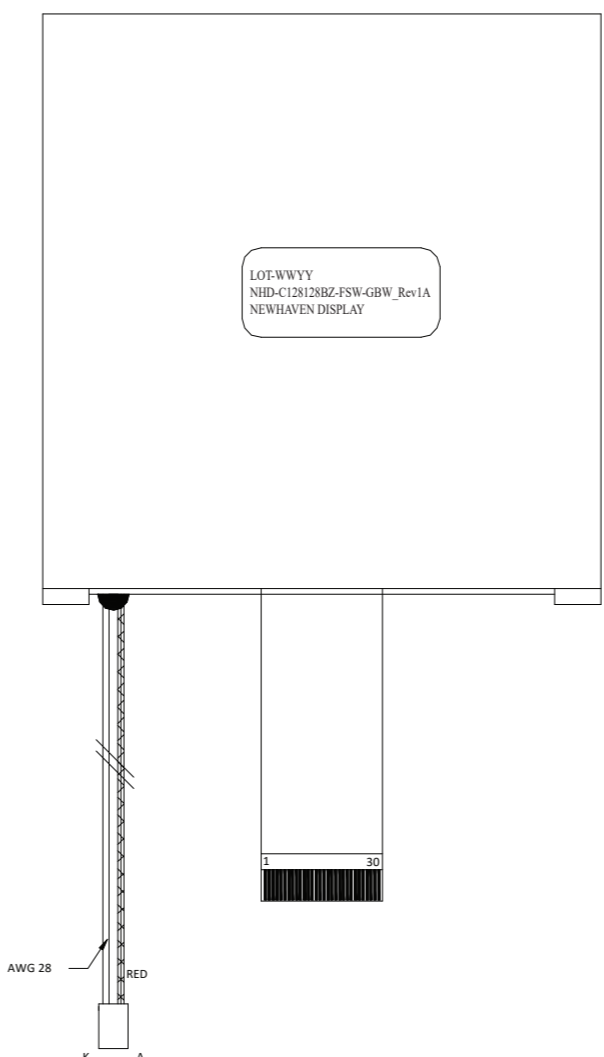
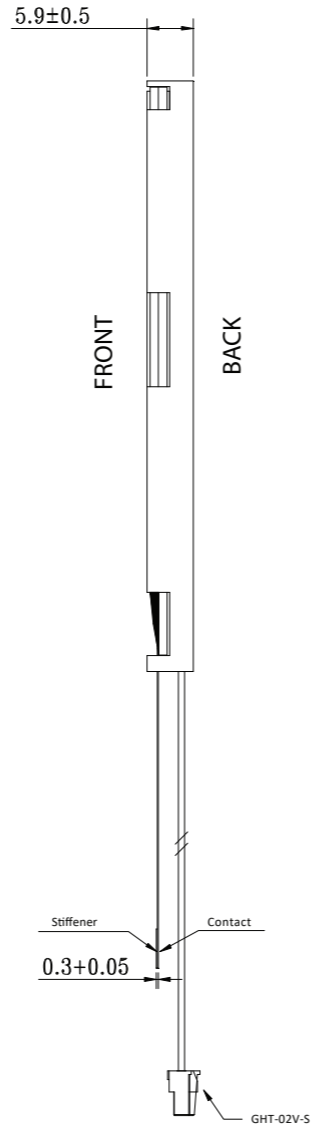
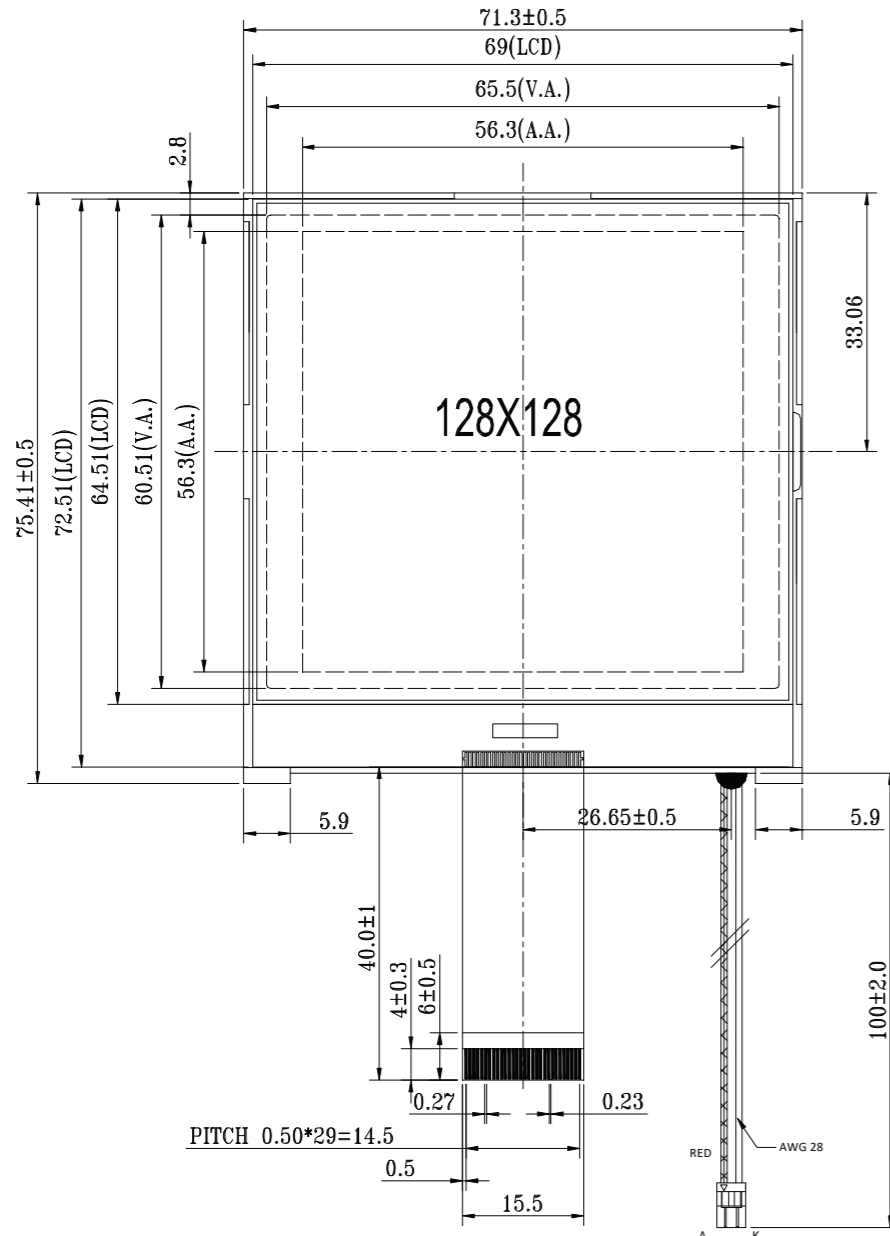
## Document Revision History

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

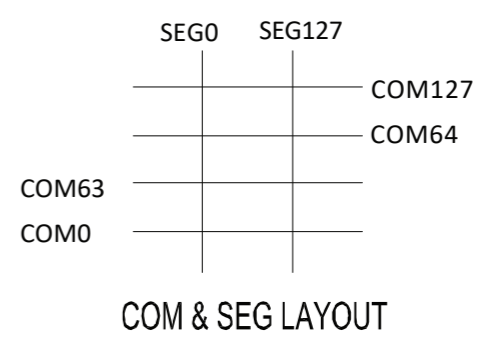
- 128 x 128 pixels
- Built-in ST7528 controller
- +3.0V power supply
- 1/128 duty cycle; 1/12 bias
- RoHS Compliant

SYMBOL	REVISION	DATE

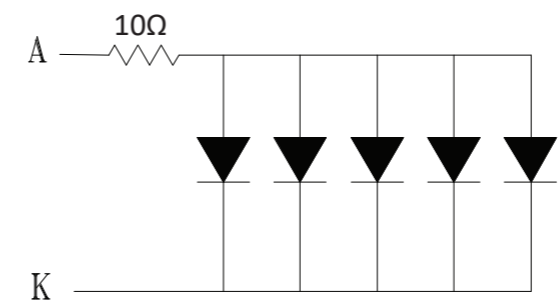


**PIN ASSIGNMENT**

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	VOU-OUT
22	VOU-IN
23	V4
24	V3
25	V2
26	V1
27	V0
28	VR
29	INTRS
30	NC



- Notes:**
- Driver: 1/128 Duty, 1/12 Bias
  - Display Mode: STN Positive / Gray / Transflective
  - Optimal View: 6:00
  - Voltage: 3.0V VDD, 13.6V VLCD
  - Backlight: White LED
  - Driver IC: ST7528



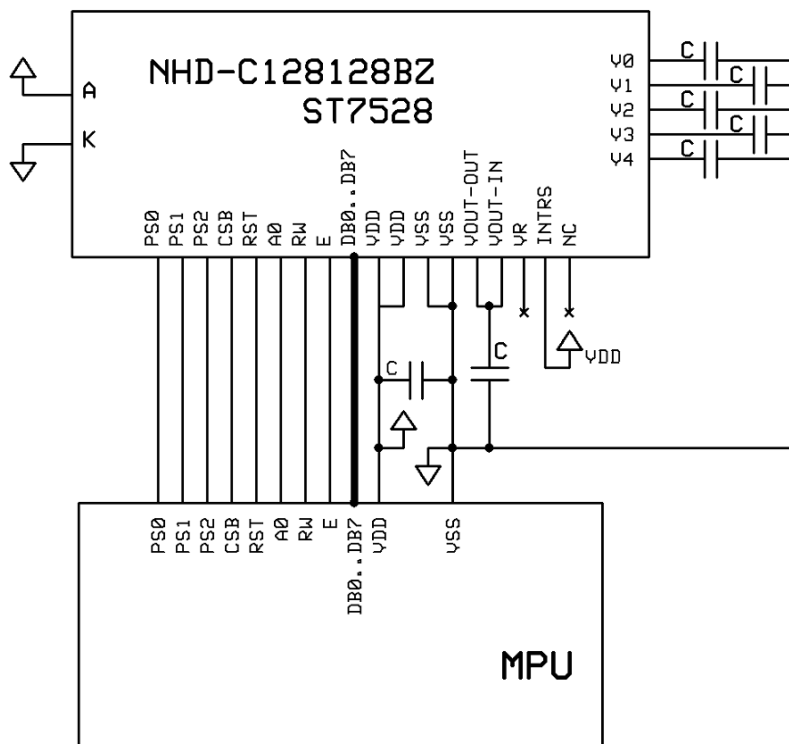
STANDARD TOLERANCE: (UNLESS OTHERWISE SPECIFIED)		
LINEAR: ±0.3mm	DRAWING/PART NUMBER: <b>NHD-C128128BZ-FSW-GBW</b>	REVISION: 1A
UNLESS OTHERWISE SPECIFIED: - DIMENSIONS ARE IN MILLIMETERS - THIRD ANGLE PROJECTION	DRAWN BY: S. Baxi	APPROVED BY: S. Baxi
	DRAWN DATE: 1/16/20	APPROVED DATE: 1/16/20
	DO NOT SCALE DRAWING	
	SHEET 1 OF 1	
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## 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	
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 <sub>DD</sub>	Power Supply	Supply Voltage for logic (3.0V)
19,20	V <sub>SS</sub>	Power Supply	Ground
21	V <sub>OUT</sub>	Power Supply	Voltage booster circuit – connect to 1uF cap to V <sub>SS</sub> or V <sub>DD</sub>
22	V <sub>IN</sub>	Power Supply	Tie to V <sub>OUT</sub>
23	V <sub>4</sub>	Power Supply	1.0uF-2.2uF cap to V <sub>SS</sub>
24	V <sub>3</sub>	Power Supply	1.0uF-2.2uF cap to V <sub>SS</sub>
25	V <sub>2</sub>	Power Supply	1.0uF-2.2uF cap to V <sub>SS</sub>
26	V <sub>1</sub>	Power Supply	1.0uF-2.2uF cap to V <sub>SS</sub>
27	V <sub>0</sub>	Power Supply	1.0uF-2.2uF cap to V <sub>SS</sub>
28	V <sub>R</sub>	-	No Connect
29	INTRS	Input	Internal resistor select pin: V <sub>DD</sub> =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 <sub>OP</sub>	Absolute Max	-20	-	+70	°C
Storage Temperature Range	T <sub>ST</sub>	Absolute Max	-30	-	+80	°C
Supply Voltage	V <sub>DD</sub>	-	2.7	3.0	3.3	V
Supply Current	I <sub>DD</sub>	V <sub>DD</sub> = 3.0V	0.5	1.0	1.5	mA
Supply for LCD (contrast)	V <sub>LCD</sub>	T <sub>OP</sub> = 25°C	13.3	13.6	13.9	V
"H" Level input	V <sub>IH</sub>	-	2.2	-	V <sub>DD</sub>	V
"L" Level input	V <sub>IL</sub>	-	V <sub>SS</sub>	-	0.6	V
"H" Level output	V <sub>OH</sub>	-	2.4	-	V <sub>DD</sub>	V
"L" Level output	V <sub>OL</sub>	-	V <sub>SS</sub>	-	0.4	V
Backlight supply voltage	V <sub>LED</sub>	-	3.0	3.3	3.5	V
Backlight supply current	I <sub>LED</sub>	V <sub>LED</sub> = 3.3V	30	45	60	mA

## Optical Characteristics

Item	Symbol	Condition	Min.	Typ.	Max.	Unit
Optimal Viewing Angles	Top	CR ≥ 2	-	35	-	°
	Bottom		-	60	-	°
	Left		-	60	-	°
	Right		-	60	-	°
Contrast Ratio	CR	-	2	6	-	-
Response Time	Rise	T <sub>OP</sub> = 25°C	-	150	250	ms
	Fall		-	200	300	ms

## Controller Information

Built-in ST7528 controller.

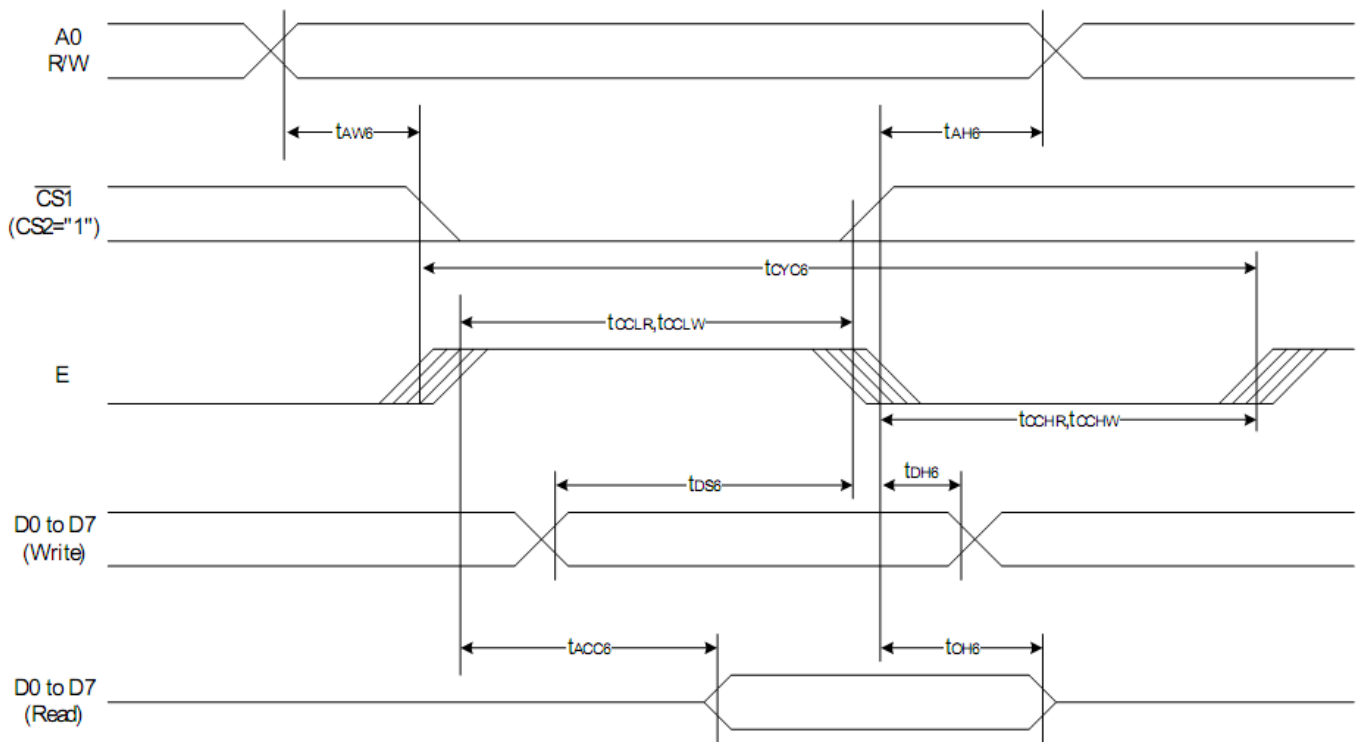
Please download specification at [http://www.newhavendisplay.com/app\\_notes/ST7528.pdf](http://www.newhavendisplay.com/app_notes/ST7528.pdf)

## Table of Commands

Instruction	A0	RW	DB7	DB6	DB5	DB4	DB3	DB2	DB1	DB0	Description
<b>EXT=0 or 1</b>											
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	
<b>EXT=0</b>											
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
<b>Ext=0</b>											
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 volume 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	<i>No operation</i>
Test Instruction	0	0	1	1	1	1	x'	x'	x'	x'	<i>Don't use this instruction</i>

# Timing Characteristics



Item	Signal	Symbol	Condition	Rating		Units
				Min.	Max.	
Address hold time	A0	$t_{AH6}$		0	—	ns
Address setup time		$t_{AW6}$		0	—	
System cycle time		$t_{CYC6}$		240	—	
Enable L pulse width (WRITE)	WR	$t_{EWLW}$		80	—	
Enable H pulse width (WRITE)		$t_{EWHW}$		80	—	
Enable L pulse width (READ)	RD	$t_{EWLR}$		80	—	
Enable H pulse width (READ)		$t_{EWHR}$		140	—	
WRITE Data setup time	D0 to D7	$t_{DS6}$		40	—	
WRITE Data hold time		$t_{DH6}$		10	—	
READ access time		$t_{ACC6}$	CL = 100 pF	—	70	
READ Output disable time		$t_{OH6}$	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](http://www.newhavendisplay.com/specs/precautions.pdf)

## Warranty Information and Terms & Conditions

[http://www.newhavendisplay.com/index.php?main\\_page=terms](http://www.newhavendisplay.com/index.php?main_page=terms)