

# NHD-C160100CZ-RN-FBW

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

NHD- Newhaven Display  
C160100- 160 x 100 Pixels  
CZ- Model  
R- Reflective  
N- No Backlight  
F- FSTN Positive  
B- 6:00 Optimal View  
W- Wide Temperature  
**RoHS Compliant**

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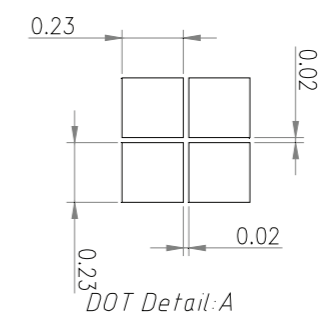
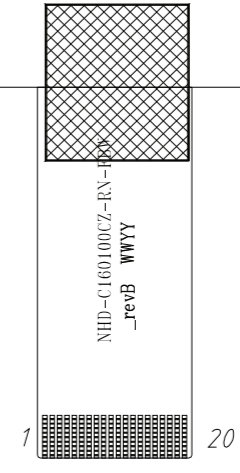
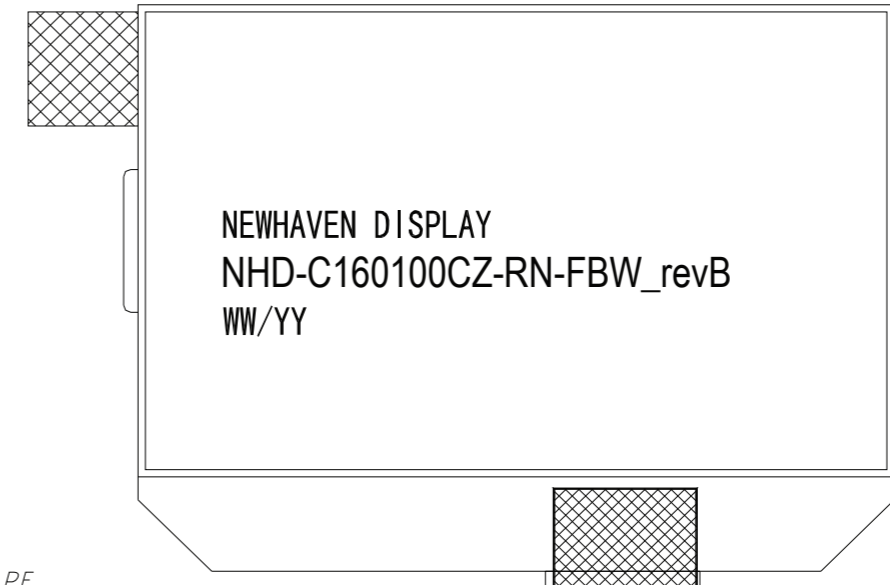
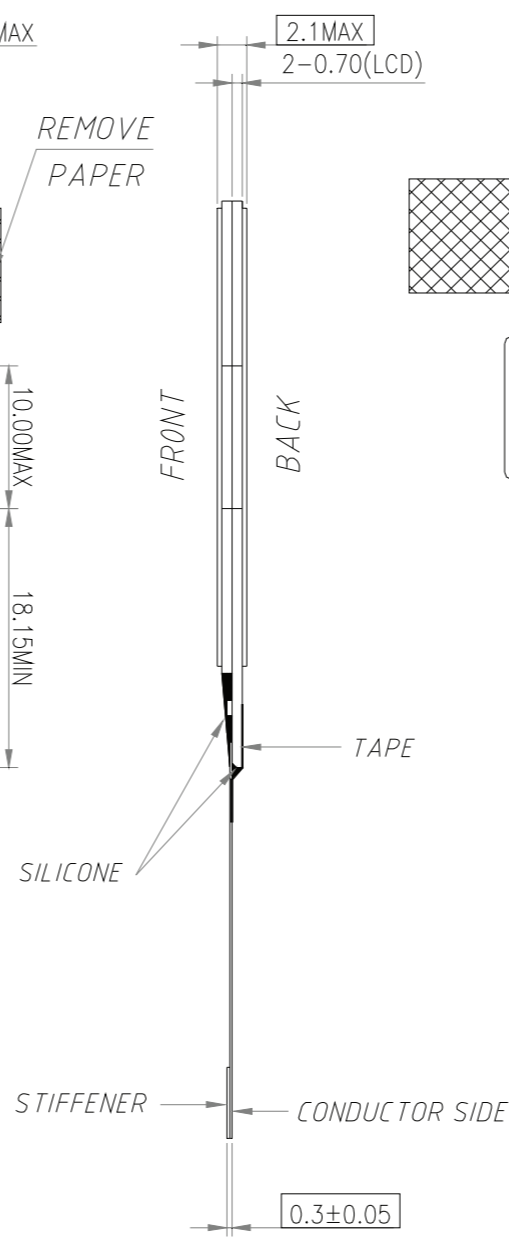
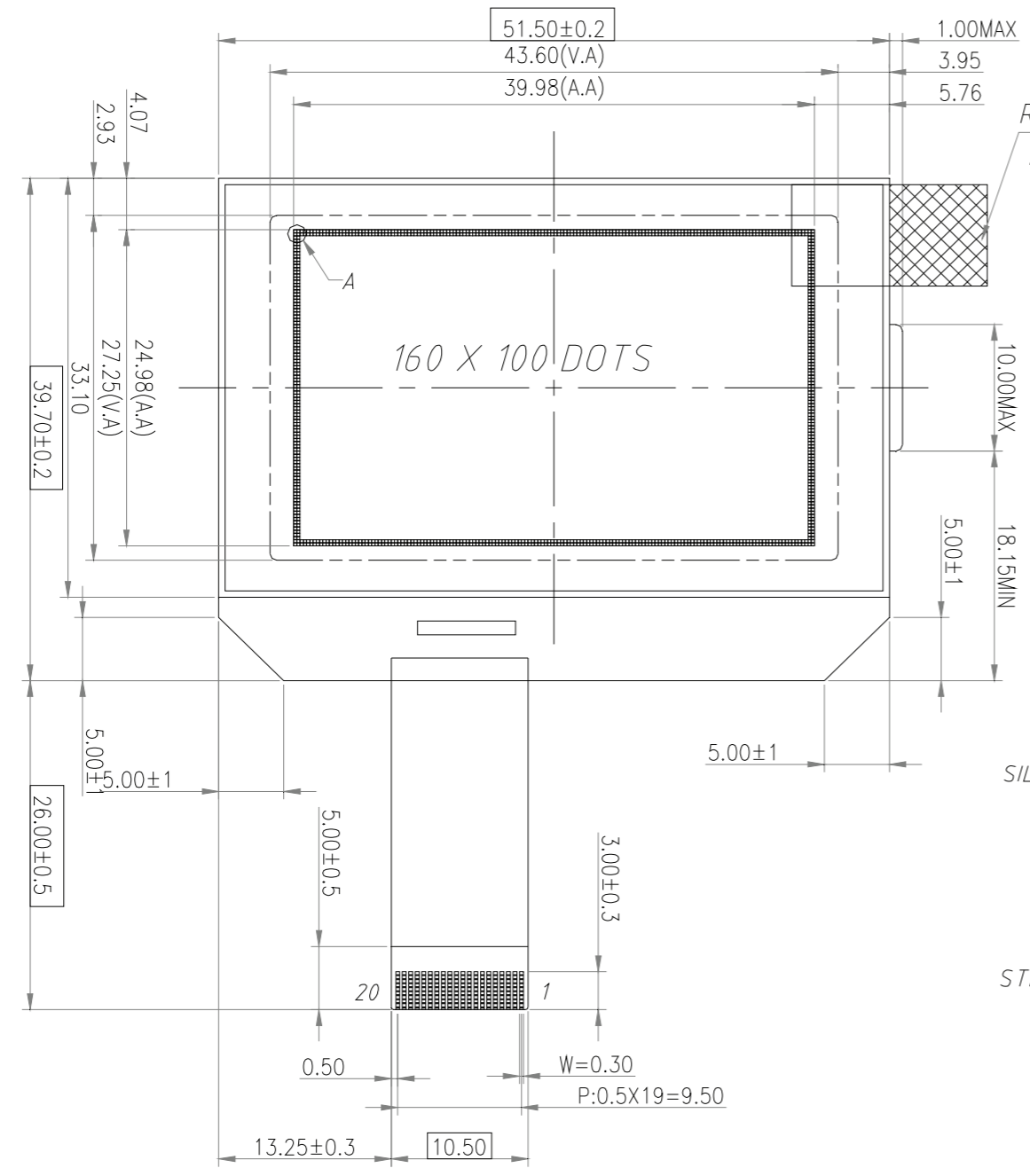
## Document Revision History

Revision	Date	Description	Changed by
0	6/17/2007	Initial Release	-
1	9/11/2009	User guide reformat	BE
2	10/14/2009	Updated Electrical Characteristic	MC
3	12/08/2009	Updated Block Diagram, Pins 4 and 5, and Timing Characteristics	MC
4	9/2/15	Mechanical drawing updated	AK
5	9/18/2015	Mechanical drawing updated	SB
6	8/9/16	LCD Glass supplier changed	AK
7	6/11/19	Pull Tab added to Drawing & Supply Current Updated	SB

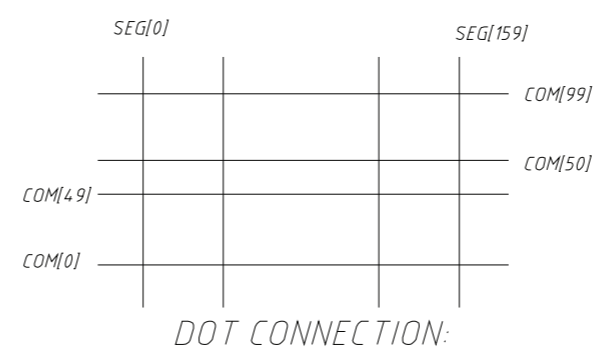
## Functions and Features

- 160 x 100 pixels
- Built-in ST7528 controller
- Parallel 8080 interface
- +3.0V power supply
- 1/100 duty cycle; 1/11 bias
- RoHS Compliant

SYMBOL	REVISION	DATE



PIN	FUNCTION
1	CSB
2	RST
3	A0
4	/WR
5	/RD
6	DB0
7	DB1
8	DB2
9	DB3
10	DB4
11	DB5
12	DB6
13	DB7
14	VDD
15	VSS
16	VOUT
17	V4
18	V3
19	V2
20	V1



- Notes:**
1. Display Type: FSTN / Positive / Reflective
  2. VLCD: 11.5V ± 0.3V
  3. Driver IC: ST7528
  4. Operating Temp: -20°C to +70°C
  5. Storage Temp: -30°C to +80°C
  6. Optimal View: 6:00

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-C160100CZ-RN-FBW

REVISION: B

SIZE: A3

SCALE: NS

DO NOT SCALE DRAWING

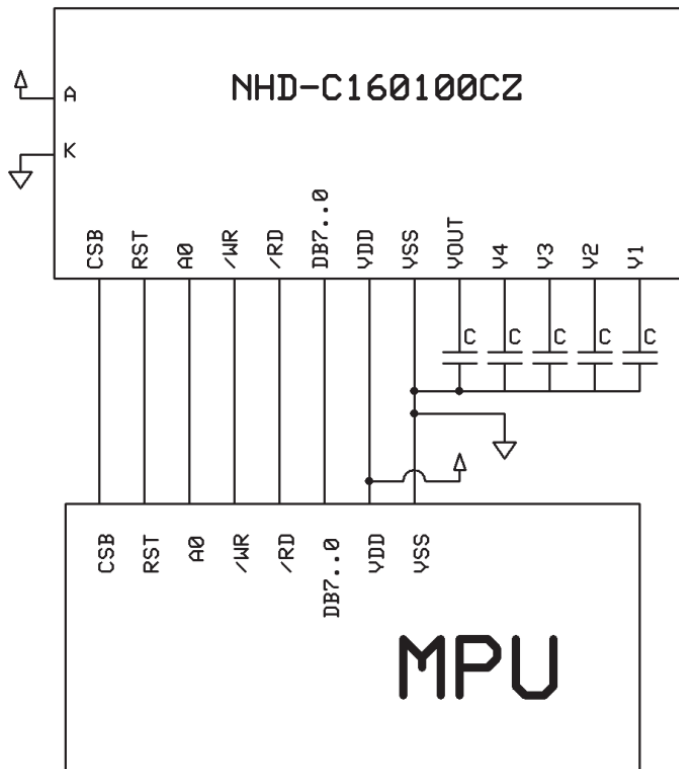
SHEET 1 OF 1

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## Pin Description and Wiring Diagram

Pin No.	Symbol	External Connection	Function Description
1	CSB	MPU	Active LOW Chip Select signal
2	RST	MPU	Active LOW Reset signal
3	A0	MPU	Register Select signal. A0=1: Data, A0=0: Command
4	/WR	MPU	Active LOW Write signal
5	/RD	MPU	Active LOW Read signal
6-13	DB0-DB7	MPU	Bi-directional 8-bit data bus.
14	V <sub>DD</sub>	Power Supply	Supply voltage for LCD and logic (+3.0V)
15	V <sub>SS</sub>	Power Supply	Ground
16	V <sub>OUT</sub>	Power Supply	Connect to 1uF cap to V <sub>SS</sub> or V <sub>DD</sub>
17	V <sub>4</sub>	Power Supply	1.0uF-2.2uF cap to V <sub>SS</sub>
18	V <sub>3</sub>	Power Supply	1.0uF-2.2uF cap to V <sub>SS</sub>
19	V <sub>2</sub>	Power Supply	1.0uF-2.2uF cap to V <sub>SS</sub>
20	V <sub>1</sub>	Power Supply	1.0uF-2.2uF cap to V <sub>SS</sub>

**Recommended LCD connector:** 0.5mm pitch pins. Molex p/n: 52746-2070



## 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>	T <sub>OP</sub> =25°C, V <sub>DD</sub> =3.0V	0.38	0.75	1.13	mA
Supply for LCD (contrast)	V <sub>LCD</sub>		11.2	11.5	11.8	V
"H" Level input	V <sub>IH</sub>	-	0.7*V <sub>DD</sub>	-	V <sub>DD</sub>	V
"L" Level input	V <sub>IL</sub>	-	V <sub>SS</sub>	-	0.3*V <sub>DD</sub>	V
"H" Level output	V <sub>OH</sub>	-	0.7*V <sub>DD</sub>	-	V <sub>DD</sub>	V
"L" Level output	V <sub>OL</sub>	-	V <sub>SS</sub>	-	0.3*V <sub>DD</sub>	V

## Optical Characteristics

Item	Symbol	Condition	Min.	Typ.	Max.	Unit
Optimal Viewing Angles	Top	CR≥2	-	20	-	°
	Bottom		-	40	-	°
	Left		-	45	-	°
	Right		-	45	-	°
Contrast Ratio	CR	-	2	4	-	-
Response Time	Rise	T <sub>OP</sub> = 25°C	-	70	104	ms
	Fall		-	140	215	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

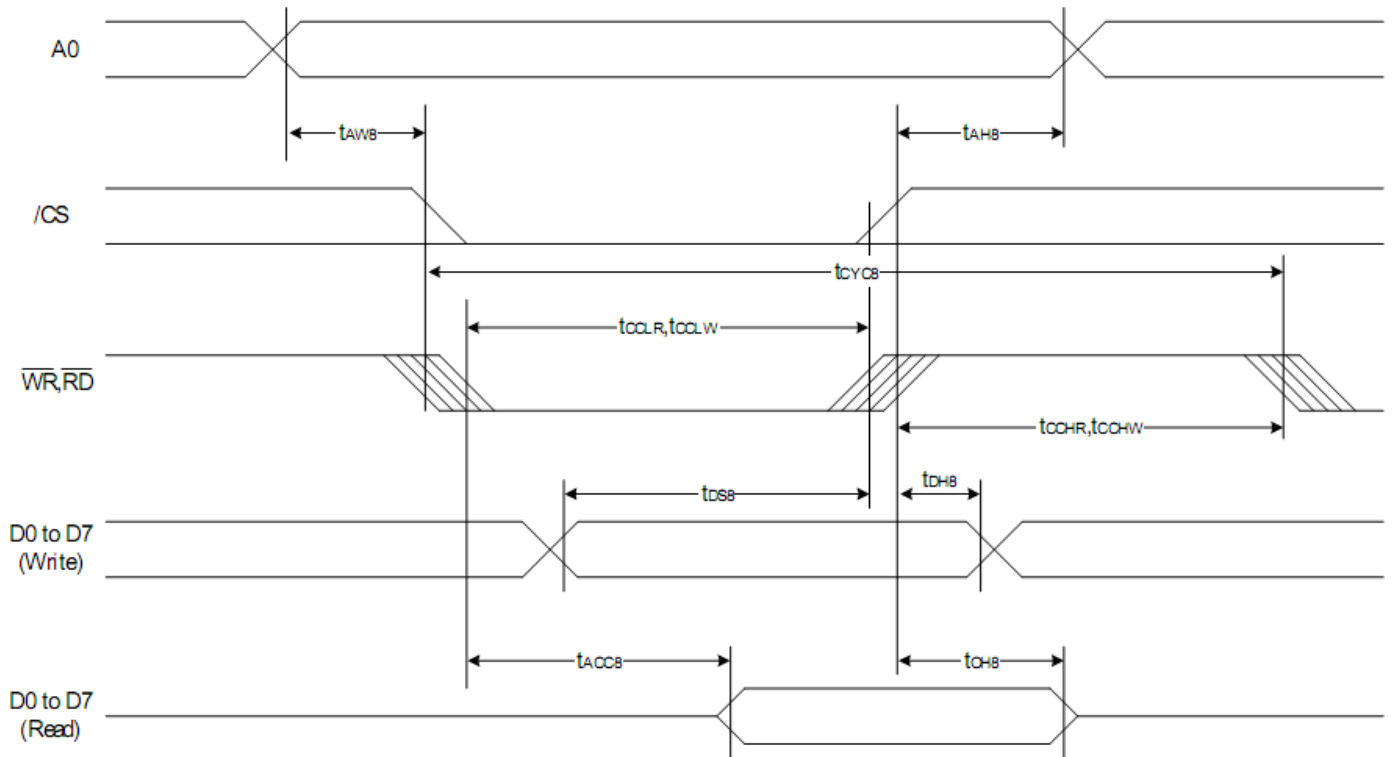
Instruction	A0	RW	DB7	DB6	DB5	DB4	DB3	DB2	DB1	DB0	Description
<b>EXT=0 or 1</b>											
Mode Set	0	0	0	0	1	1	1	0	0	0	2-byte instruction to set Mode and FR( Frame frequency control) BE( Booster efficiency control)
	0	0	FR3	FR2	FR1	FR0	0	BE	x'	EXT	
<b>EXT=0</b>											
Read display data	1	1	Read 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 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
Set Bias Power Save Mode	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	
Release Bias Power Save Mode	0	0	1	1	1	1	0	0	1	1	Bias Power save release set the Bias power to normal
	0	0	0	0	0	0	0	1	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	<u>No operation</u>
Test Instruction	0	0	1	1	1	1	x'	x'	x'	x'	<u>Don't use this instruction</u>

Instruction	A0	RW	DB7	DB6	DB5	DB4	DB3	DB2	DB1	DB0	Description
<b>EXT=1</b>											
Set white mode and 1 <sup>st</sup> frame, set pulse width	0	0	1	0	0	0	0	0	0	0	Set white mode and 1st frame
	0	0	X'	X'	GA05	GA04	GA03	GA02	GA01	GA00	
Set white mode and 2 <sup>nd</sup> frame, set pulse width	0	0	1	0	0	0	0	0	0	1	Set white mode and 2nd frame
	0	0	X'	X'	GA05	GA04	GA03	GA02	GA01	GA00	
Set white mode and 3 <sup>rd</sup> frame, set pulse width	0	0	1	0	0	0	0	0	1	0	Set white mode and 3rd frame
	0	0	X'	X'	GA05	GA04	GA03	GA02	GA01	GA00	
Set white mode and 4 <sup>th</sup> frame, set pulse width	0	0	1	0	0	0	0	0	1	1	Set white mode and 4th frame
	0	0	X'	X'	GA05	GA04	GA03	GA02	GA01	GA00	
Set gray level 1 mode	0	0	84H~87H (4 bytes)								Set gray level1
Set gray level 2 mode	0	0	88H~8BH (4 bytes)								Set gray level2
Set gray level 3 mode	0	0	8CH~8FH (4bytes)								Set gray level3
Set gray level 4 mode	0	0	90H~93H (4bytes)								Set gray level4
Set gray level 5 mode	0	0	94H~97H (4bytes)								Set gray level5
Set gray level 6 mode	0	0	98H~9BH (4 bytes)								Set gray level6
Set gray level 7 mode	0	0	9CH~9FH (4 bytes)								Set gray level7
Set gray level 8 mode	0	0	A0H~A3H (4 bytes)								Set gray level8
Set gray level 9 mode	0	0	A4H~A7H (4 bytes)								Set gray level9
Set gray level 10 mode	0	0	A8H~ABH (4 bytes)								Set gray level10
Set gray level 11mode	0	0	ACH~AFH (4 bytes)								Set gray level11
Set gray level 12 mode	0	0	B0H~B3H (4 bytes)								Set gray level12
Set gray level 13 mode	0	0	B4H~B7H (4 bytes)								Set gray level13
Set gray level 14 mode	0	0	B8H~BBH (4 bytes)								Set gray level14
Set Dark mode and 1st frame, set pulse width	0	0	1	0	1	1	1	1	0	0	Set Dark mode and 1st frame, set pulse width
	0	0	X'	X'	GAF5	GAF4	GAF3	GAF2	GAF1	GAF0	
Set Dark mode and 2nd frame, set pulse width	0	0	1	0	1	1	1	1	0	1	Set Dark mode and 2nd frame, set pulse width
	0	0	X'	X'	GAF5	GAF4	GAF3	GAF2	GAF1	GAF0	
Set Dark mode and 3rd frame, set pulse width	0	0	1	0	1	1	1	1	1	0	Set Dark mode and 3rd frame, set pulse width
	0	0	X'	X'	GAF5	GAF4	GAF3	GAF2	GAF1	GAF0	
Set Dark mode and 4th frame, set pulse width	0	0	1	0	1	1	1	1	1	1	Set Dark mode and 4th frame, set pulse width
	0	0	X'	X'	GAF5	GAF4	GAF3	GAF2	GAF1	GAF0	



# Timing Characteristics



(VDD = 3.3V , Ta =25°C)

Item	Signal	Symbol	Condition	Rating		Units
				Min.	Max.	
Address hold time	A0	tAH8		0	—	ns
Address setup time		tAW8		0	—	
System cycle time		tCYC8		240	—	
Enable L pulse width (WRITE)	WR	tCCLW		80	—	
Enable H pulse width (WRITE)		tCCHW		80	—	
Enable L pulse width (READ)	RD	tCCLR		140	—	
Enable H pulse width (READ)		tCCHR		80	—	
WRITE Data setup time	D0 to D7	tDS8		40	—	
WRITE Data hold time		tDH8		10	—	
READ access time		tACC8	CL = 100 pF	—	70	
READ Output disable time		tOH8	CL = 100 pF	5	50	

## Example Initialization Program

```
//-----  
void write_command(unsigned char datum)  
{  
    A0=0; /*Instruction register*/  
    E=1; /*Read inactive*/  
    P1 = datum; /*put data on port 1*/  
    CS1=0; /*Chip select active*/  
    RW=0; /*Write active*/  
    RW=1; /*Write inactive; latch in data*/  
    CS1=1; /*Chip select inactive*/  
}  
  
//-----  
void write_data(unsigned char datum)  
{  
    A0=1; /*DDRAM data register*/  
    E=1;  
    P1=datum;  
    CS1=0;  
    RW=0;  
    RW=1;  
    CS1=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(0xa1); //Set scan direction //changed from 0 to 1  
    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)