

# NHD-320240WG-BoTFH-VZ#

## Graphic Liquid Crystal Display Module

NHD-	Newhaven Display
320240-	320 x 240 pixels
WG-	Display Type: Graphic
Bo-	Model
T-	White LED Backlight
F-	FSTN (+)
H-	Transflective, 6:00 view, Wide Temperature (-20°C ~+70°C)
VZ#-	Built-in Negative Voltage
	<b>RoHS Compliant</b>

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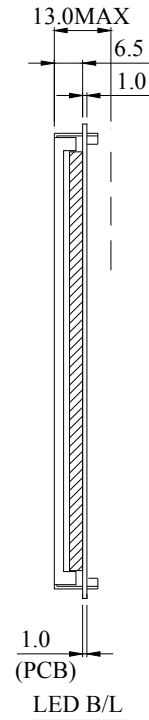
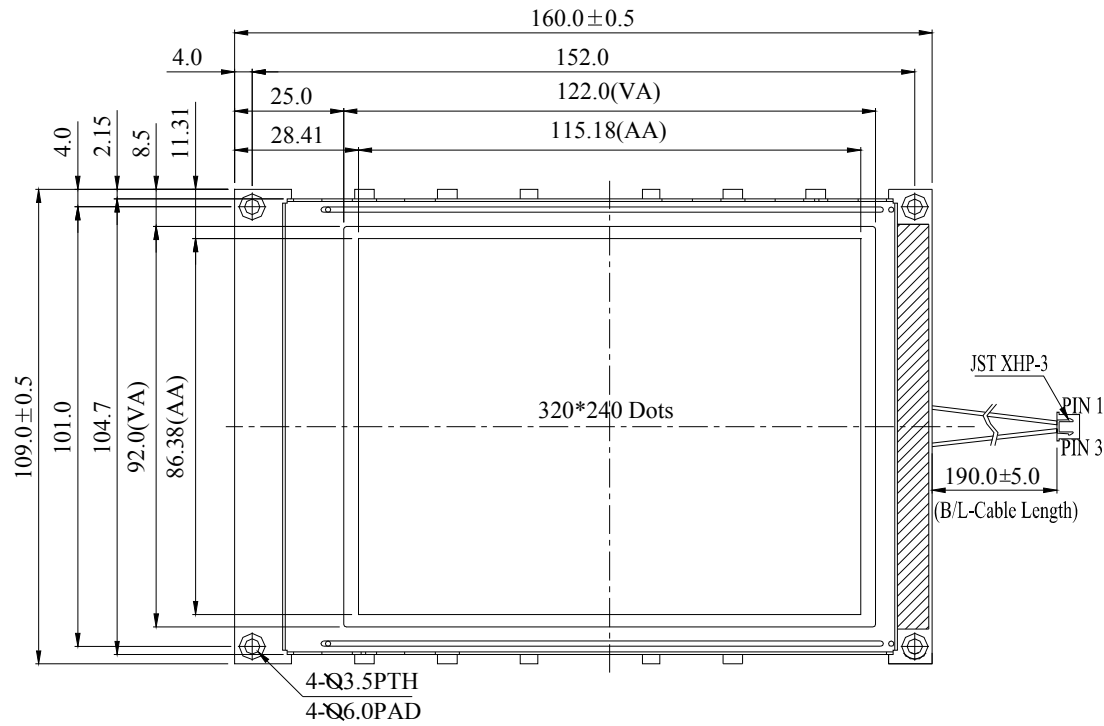
## Document Revision History

Revision	Date	Description	Changed by
0	6/7/2007	Initial Release	-
1	4/15/2010	User guide reformat	MC

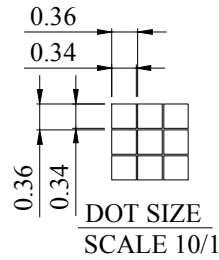
## Functions and Features

- 320 x 240 pixels
- Built-in RA8835 Controller
- +5.0V power supply
- RoHS Compliant

# Mechanical Drawing



PIN NO.	SYMBOL
1	VSS
2	Vcc
3	Vo
4	A0
5	R/W
6	E
7	DB0
8	DB1
9	DB2
10	DB3
11	DB4
12	DB5
13	DB6
14	DB7
15	/CS
16	/RST
17	Vee
18	NC
19	FG
20	NC



The non-specified tolerance of dimension is  $\pm 0.3\text{mm}$ .

Newhaven Display

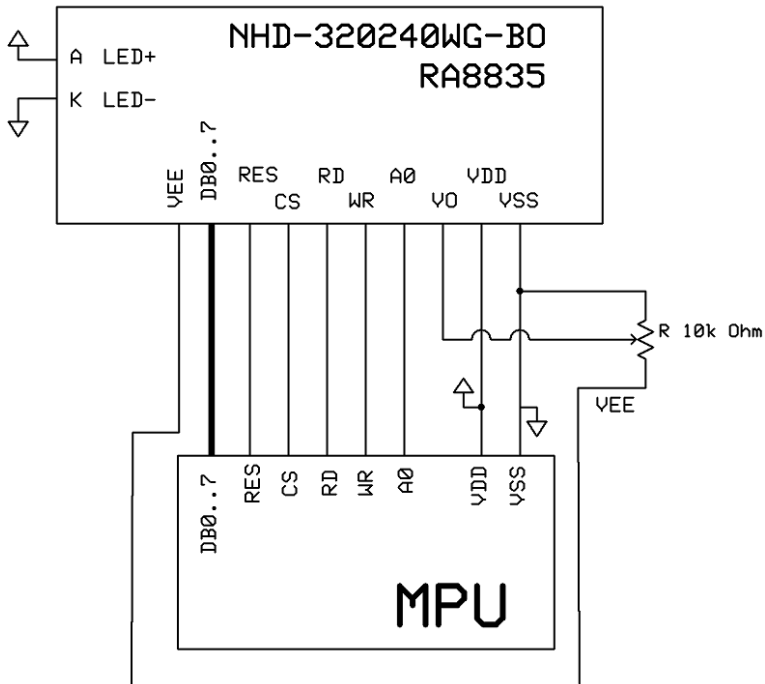
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## Pin Description and Wiring Diagram

Pin No.	Symbol	External Connection	Function Description
1	VSS	Power Supply	Ground
2	VDD	Power Supply	Power supply for logic (+5.0V)
3	V0	Adj Power Supply	Power supply for contrast (approx. -19.0V)
4	A0	MPU	Register select signal. A0=0: Command, A0=1: Data
5	R/W	MPU	Read/Write select signal, R/W=1: Read R/W=0: Write
6	E	MPU	Operation enable signal. Falling edge triggered.
7-14	DB0-DB7	MPU	Bi-directional three-state data bus lines.
15	/CS	MPU	Active LOW chip select
16	/RST	MPU	Active LOW reset signal
17	VEE	Power Supply	Negative voltage output (-25V)
18	NC	-	No Connect
19	FG	-	No Connect
20	NC	-	No Connect

**Recommended LCD connector:** 1.0mm pitch, 20-pos FFC connector

**Backlight connector:** JST p/n: XHP-3    **Mates with:** JST p/n: B 3B-XH-A



## Electrical Characteristics

Item	Symbol	Condition	Min.	Typ.	Max.	Unit
Operating Temperature Range	Top	Absolute Max	-20	-	+70	°C
Storage Temperature Range	Tst	Absolute Max	-30	-	+80	°C
Supply Voltage	VDD		4.5	5.0	5.5	V
Supply Current	IDD	Ta=25°C, VDD=5.0V	95.0	100.0	110.0	mA
Supply for LCD (contrast)	VDD-VLCD	Ta=25°C	22.0	24.0	26.0	V
"H" Level input	VIH		0.5VDD	-	VDD	V
"L" Level input	VIL	-	0	-	0.2VDD	V
"H" Level output	VOH	-	2.4	-	-	V
"L" Level output	VOL	-	-	-	0.4	V
Backlight Supply Voltage	VLED		3.4	3.5	3.6	V
Backlight Supply Current	ILED	VLED=3.5V	120	160	240	mA
Backlight Lifetime		ILED=160mA	-	50,000	-	Hrs

## Optical Characteristics

Item	Symbol	Condition	Min.	Typ.	Max.	Unit
Viewing Angle - Vertical	AV	Cr ≥ 2	-30	-	60	°
Viewing Angle - Horizontal	AH	Cr ≥ 2	-45	-	45	°
Contrast Ratio	Cr		-	5	-	-
Response Time (rise)	Tr	-	-	200	300	ms
Response Time (fall)	Tf	-	-	150	200	ms

## Controller Information

Built-in RA8835. Download specification at [http://www.newhavendisplay.com/app\\_notes/RA8835.pdf](http://www.newhavendisplay.com/app_notes/RA8835.pdf)

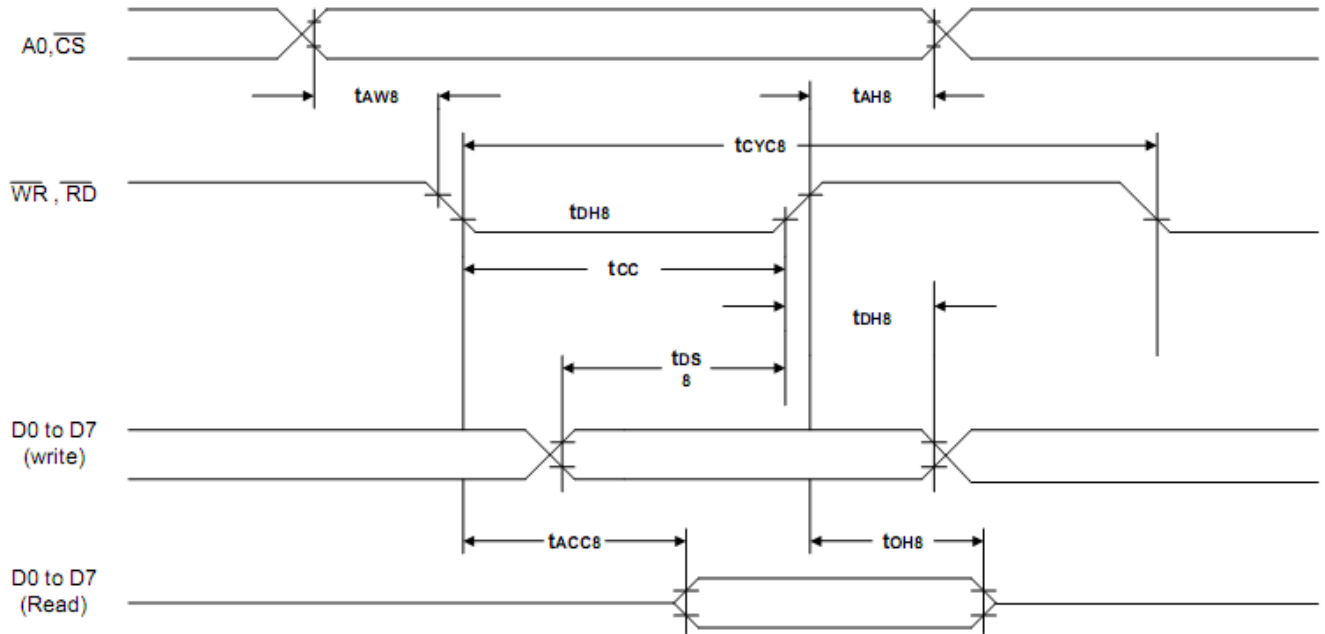
# Table of Commands

**Table-1: Command Set**

Class	Command	Code											Hex	Command Description	Command Read Parameters	
		RD	WR	A0	D7	D6	D5	D4	D3	D2	D1	D0			No. of Bytes	Section
System Control	<b>SYSTEM SET</b>	1	0	1	0	1	0	0	0	0	0	0	40	Initialize device and display	8	9-2-1
	<b>SLEEP IN</b>	1	0	1	0	1	0	1	0	0	1	1	53	Enter standby mode	0	9-2-2
Display Control	<b>DISPLAY ON/OFF</b>	1	0	1	0	1	0	1	1	0	0	D	58, 59	Enable and disable display and display flashing	1	9-3-1
	<b>SCROLL</b>	1	0	1	0	1	0	0	0	1	0	0	44	Set display start address and display regions	10	9-3-2
	<b>CSRFORM</b>	1	0	1	0	1	0	1	1	1	0	1	5D	Set cursor type	2	9-3-3
	<b>CGRAM ADR</b>	1	0	1	0	1	0	1	1	1	0	0	5C	Set start address of character generator RAM	2	9-3-6
	<b>CSRDIR</b>	1	0	1	0	1	0	0	1	1	CD 1	CD 0	4C to 4F	Set direction of cursor movement	0	9-3-4
	<b>HDOT SCR</b>	1	0	1	0	1	0	1	1	0	1	0	5A	Set horizontal scroll position	1	9-3-7
	<b>OVLAY</b>	1	0	1	0	1	0	1	1	0	1	1	5B	Set display overlay format	1	9-3-5
Drawing Control	<b>CSRW</b>	1	0	1	0	1	0	0	0	1	1	0	46	Set cursor address	2	9-r1
	<b>CSRR</b>	1	0	1	0	1	0	0	0	1	1	1	47	Read cursor address	2	9-4-2
Memory Control	<b>MWRITE</b>	1	0	1	0	1	0	0	0	0	1	0	42	Write to display memory	—	9-5-1
	<b>MREAD</b>	1	0	1	0	1	0	0	0	0	1	1	43	Read from display memory	—	9-5-2

# Timing Characteristics

## 10-3-1 8080 Family Interface Timing



$T_a = -20 \text{ to } 75^\circ\text{C}$

Signal	Symbol	Parameter	$V_{DD} = 4.5 \text{ to } 5.5\text{V}$		$V_{DD} = 2.7 \text{ to } 4.5\text{V}$		Unit	Condition
			Min.	Max.	Min.	Max.		
A0, $\overline{CS}$	$t_{AH8}$	Address hold time	10	—	10	—	ns	CL = 100pF
	$t_{AW8}$	Address setup time	0	—	0	—	ns	
$\overline{WR}$ , $\overline{RD}$	$t_{CYC8}$	System cycle time	note.	—	note.	—	ns	
	$t_{CC}$	Strobe pulse width	120	—	150	—	ns	
D0 to D7	$t_{DS8}$	Data setup time	120	—	120	—	ns	
	$t_{DH8}$	Data hold time	5	—	5	—	ns	
	$t_{ACC8}$	$\overline{RD}$ access time	—	50	—	80	ns	
	$t_{OH8}$	Output disable time	10	50	10	55	ns	

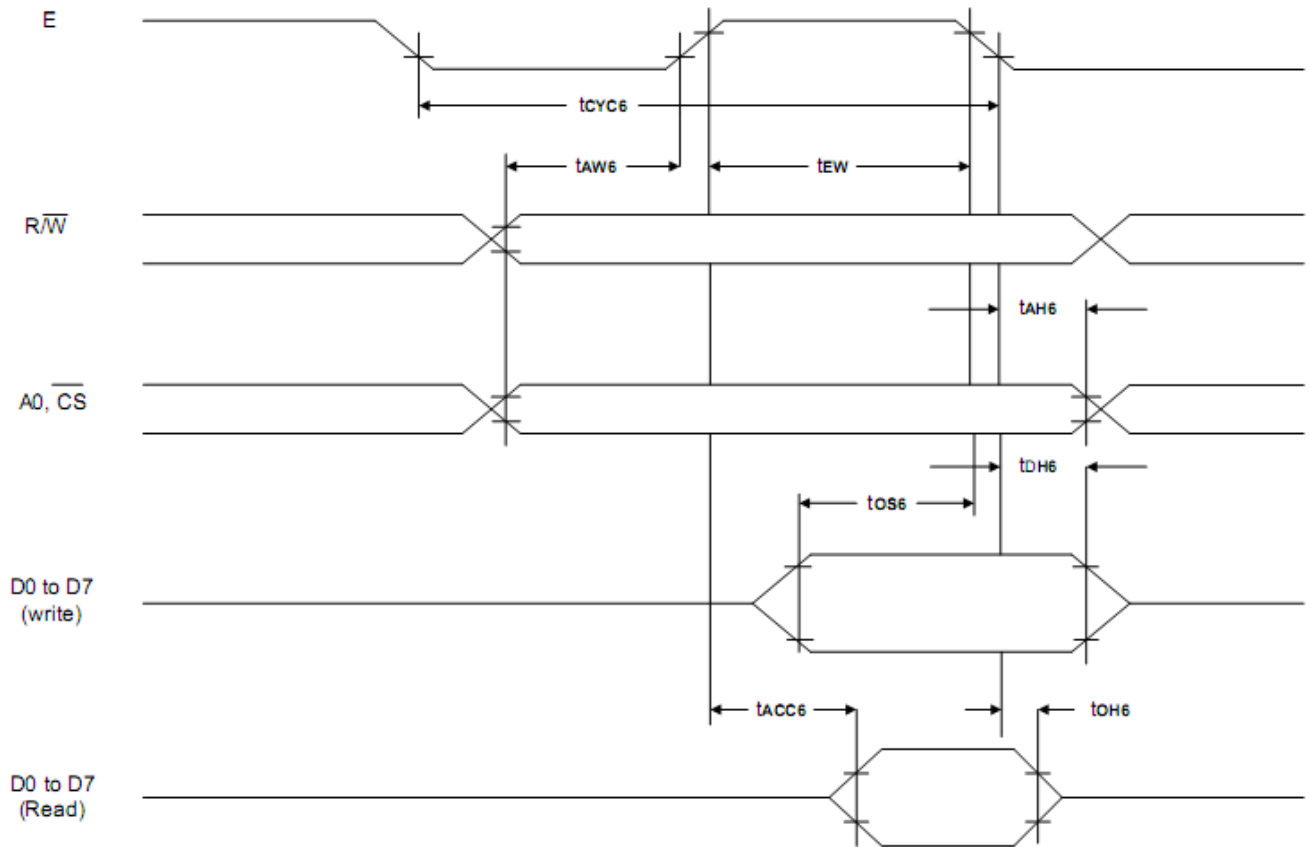
**Note:** For memory control and system control commands:

$$t_{CYC8} = 2t_C + t_{CC} + t_{CEA} + 75 > t_{ACV} + 245$$

For all other commands:

$$t_{CYC8} = 4t_C + t_{CC} + 30$$

## 10-3-2 6800 Family Interface Timing



$T_a = -20$  to  $75^\circ\text{C}$

Signal	Symbol	Parameter	$V_{DD} = 4.5$ to $5.5\text{V}$		$V_{DD} = 2.7$ to $4.5\text{V}$		Unit	Condition
			Min.	Max.	Min.	Max.		
A0, $\overline{\text{CS}}$ , R/(W)	$t_{CYC6}$	System cycle time	note.	—	note.	—	ns	CL = 100 pF
	$t_{AW6}$	Address setup time	0	—	10	—	ns	
	$t_{AH6}$	Address hold time	0	—	0	—	ns	
D0 to D7	$t_{DS6}$	Data setup time	100	—	120	—	ns	
	$t_{DH6}$	Data hold time	0	—	0	—	ns	
	$t_{OH6}$	Output disable time	10	50	10	75	ns	
	$t_{ACC6}$	Access time	—	85	—	130	ns	
E	$t_{EW}$	Enable pulse width	120	—	150	—	ns	

**Note:** For memory control and system control commands:

$$t_{CYC6} = 2t_C + t_{EW} + t_{CEA} + 75 > t_{ACV} + 245$$

For all other commands:

$$t_{CYC6} = 4t_C + t_{EW} + 30$$



## Example Initialization Program:

```
//-----
#define A0 P3_0
#define RW P3_7
#define E P3_4
#define CS P3_1
#define RESET P3_6

//-----
void data_out(unsigned char i) //Data Output 16-bit Bus Interface
{
    A0 = 0;
    P1 = i;
    CS = 0;
    RW = 0;
    E = 1;
    delay(1);
    E = 0;
    RW = 1;
    CS = 1;
}
void comm_out(unsigned char j) //Command Output 8-bit Bus Interface
{
    A0 = 1;
    P1 = j;
    CS = 0;
    RW = 0;
    E = 1;
    delay(1);
    E = 0;
    RW = 1;
    CS = 1;
}

//-----
//          Initialization For RA8835
//-----
void resetLCD()
{
    RESET = 0;
    delay(5);
    RESET = 1;
    delay(10);
}
void init_LCD()
{
    comm_out(0x40);
    delay(5);
    data_out(0x34);
}
```

## 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.	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)

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