

# 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 Positive
H-	Transflective, 6:00 Optimal View, Wide Temperature
VZ#-	Built-in Negative Voltage
	<b>RoHS Compliant</b>

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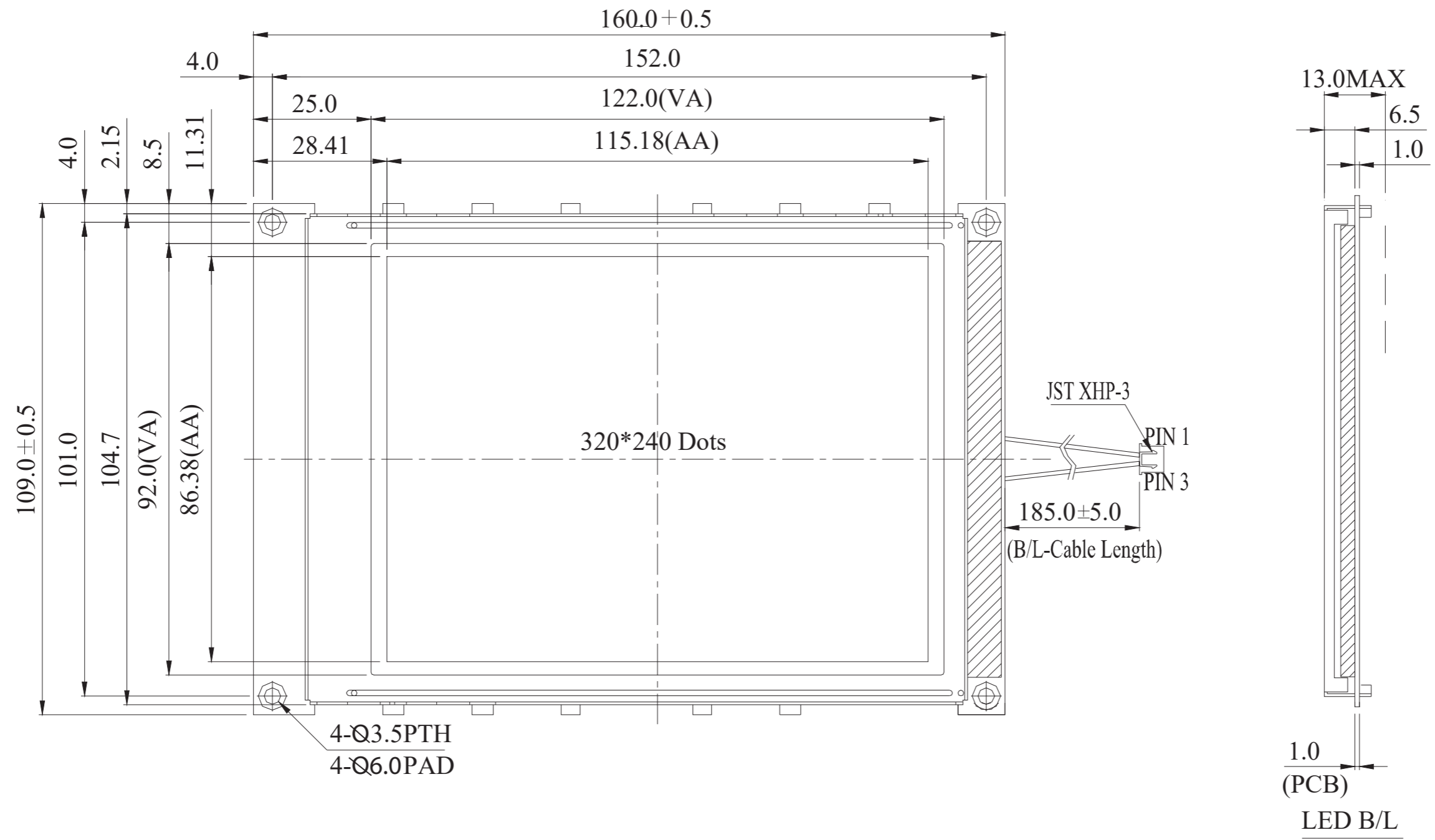
## Document Revision History

Revision	Date	Description	Changed by
0	6/7/2007	Initial Release	-
1	4/15/2010	User guide reformat	MC
2	4/27/16	Initialization code update, datasheet reformat	TM
3	11/1/16	Updated Electrical Characteristics	TM
4	11/13/17	Supply Current, Backlight Characteristics & Mechanical Drawing Updated	SB
5	10/16/19	Datasheet Reformat, Updated Pinout	AS

## Functions and Features

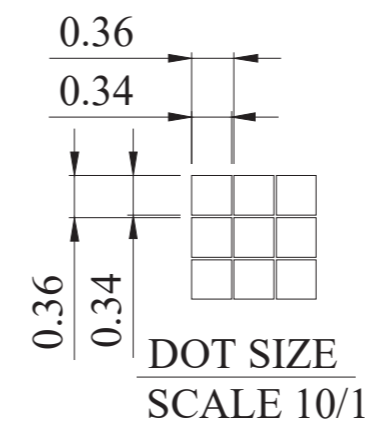
- 320 x 240 pixels
- Built-in RA8835 Controller
- +5.0V power supply
- RoHS Compliant

SYMBOL	REVISION	DATE



PIN NO.	SYMBOL
1	VSS
2	VDD
3	V <sub>o</sub>
4	A0
5	/WR
6	/RD
7	DB0
8	DB1
9	DB2
10	DB3
11	DB4
12	DB5
13	DB6
14	DB7
15	/CS
16	/RST
17	V <sub>ee</sub>
18	NC
19	FG
20	NC

- Notes:**
- Driver: 1/240 Duty
  - Display Mode: FSTN Positive / Transflective
  - Optimal View: 6:00
  - Voltage: 5.0V V<sub>DD</sub>, 23.6V V<sub>LCD</sub>
  - Backlight: White LED
  - Driver IC: RA8835



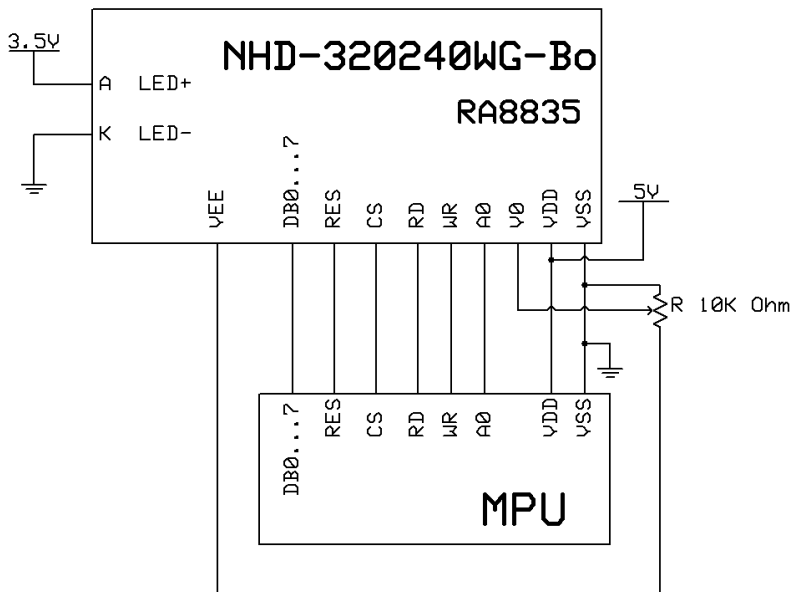
STANDARD TOLERANCE: (UNLESS OTHERWISE SPECIFIED)		
	LINEAR: ±0.3mm	REVISION: 1.0
UNLESS OTHERWISE SPECIFIED: - DIMENSIONS ARE IN MILLIMETERS - THIRD ANGLE PROJECTION	DRAWING/PART NUMBER: NHD-320240WG-BoTFH-VZ#	SIZE: A3
	DRAWN BY: A. Shah APPROVED BY: A. Shah	SCALE: NS
	DRAWN DATE: 10/16/19	APPROVED DATE: 10/16/19
	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	V <sub>SS</sub>	Power Supply	Ground
2	V <sub>DD</sub>	Power Supply	Supply Voltage for logic (+5.0V)
3	V <sub>0</sub>	Adj. Power Supply	Supply Voltage for contrast (approx. -19.0V)
4	A0	MPU	Register select signal. A0=0: Command, A0=1: Data
5	/WR R/W	MPU	8080: Active LOW Write Signal. 6800: Read/Write select signal, R/W=1: Read R/W: =0: Write
6	/RD E	MPU	8080: Active LOW Read Signal. 6800: 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	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>	-	4.5	5.0	5.5	V
Supply Current	I <sub>DD</sub>	T <sub>OP</sub> =25°C, V <sub>DD</sub> =5.0V	35	65	110	mA
Supply for LCD (contrast)	V <sub>LCD</sub>		23.0	23.6	24.2	V
"H" Level input	V <sub>IH</sub>	-	0.5 * V <sub>DD</sub>	-	V <sub>DD</sub>	V
"L" Level input	V <sub>IL</sub>	-	V <sub>SS</sub>	-	0.2 * V <sub>DD</sub>	V
"H" Level output	V <sub>OH</sub>	-	V <sub>DD</sub> - 0.4	-	V <sub>DD</sub>	V
"L" Level output	V <sub>OL</sub>	-	V <sub>SS</sub>	-	V <sub>SS</sub> + 0.4	V
Backlight Supply Current	I <sub>LED</sub>	-	-	128	160	mA
Backlight Supply Voltage	V <sub>LED</sub>	I <sub>LED</sub> = 128 mA	3.4	3.5	3.6	V
Backlight Lifetime	-	I <sub>LED</sub> =128mA T <sub>OP</sub> = 25°C	-	50,000	-	Hrs

## Optical Characteristics

Item		Symbol	Condition	Min.	Typ.	Max.	Unit
Optimal Viewing Angles	Top	φY+	Cr ≥ 2	-	30	-	°
	Bottom	φY-		-	60	-	°
	Left	θX-		-	45	-	°
	Right	θX+		-	45	-	°
Contrast Ratio		Cr	-	-	5	-	-
Response Time	Rise	T <sub>r</sub>	T <sub>OP</sub> = 25°C	-	200	300	ms
	Fall	T <sub>f</sub>		-	150	200	ms

## Controller Information

Built-in RA8835 controller.

Please download specification at [http://www.newhavendisplay.com/app\\_notes/RA8835.pdf](http://www.newhavendisplay.com/app_notes/RA8835.pdf)

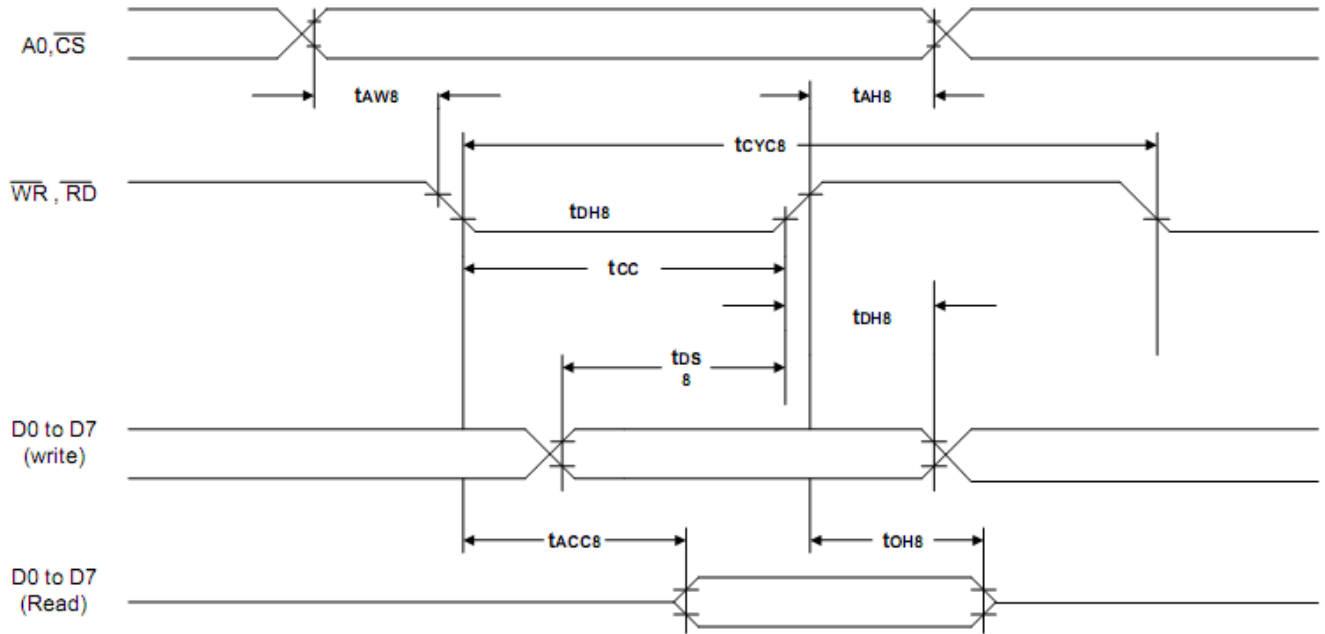
# Table of Commands

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	

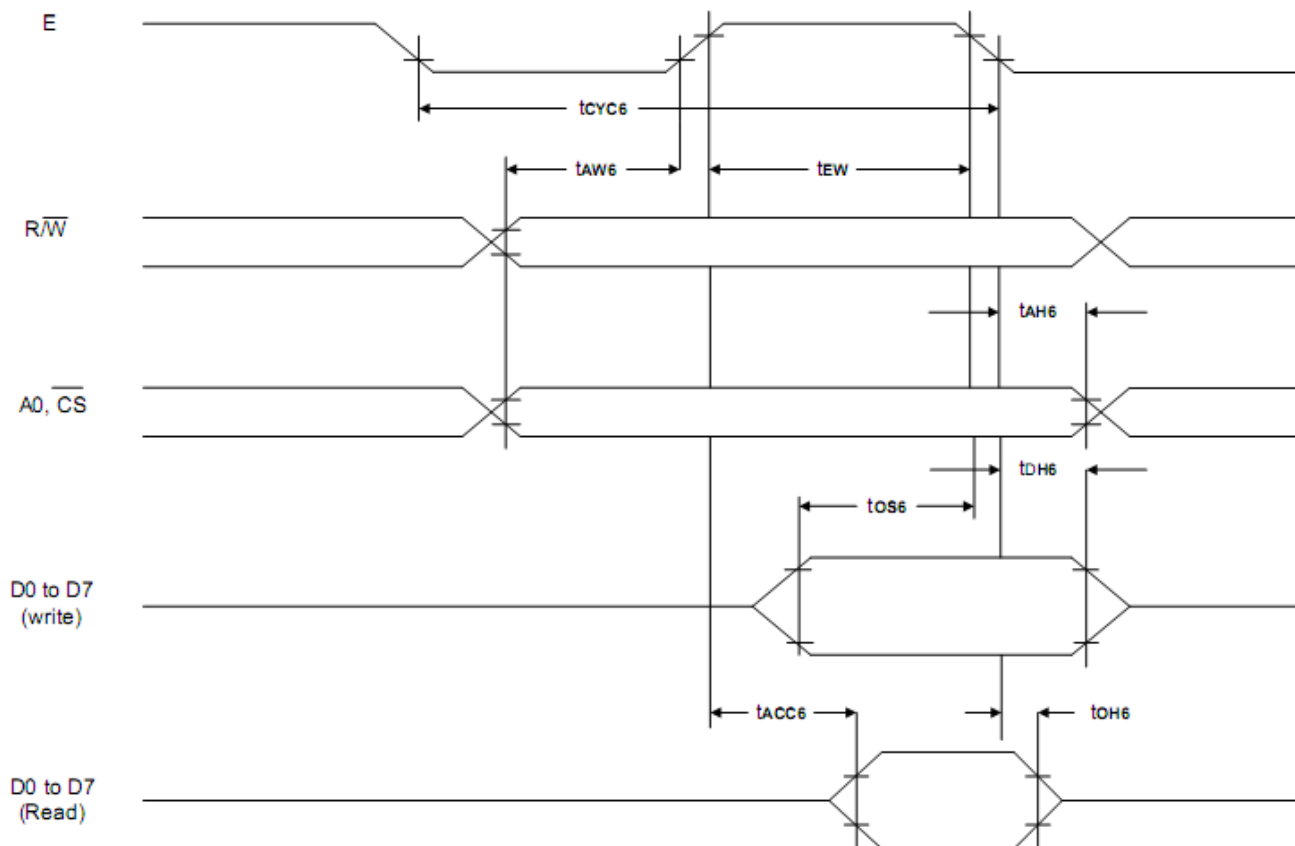
**Note:** For memory control and system control commands:

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

For all other commands:

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

### 10-3-2 6800 Family Interface Timing



Ta = -20 to 75°C

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

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

$$t_{\text{CYC6}} = 2t_{\text{C}} + t_{\text{EW}} + t_{\text{CEA}} + 75 > t_{\text{ACV}} + 245$$

For all other commands:

$$t_{\text{CYC6}} = 4t_{\text{C}} + t_{\text{EW}} + 30$$



## Example Initialization Program:

```
//-----6800 Parallel Interface-----
#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);
data_out(0x87);
data_out(0x07);
data_out(0x27);
data_out(0x39);
data_out(0xEF);
data_out(0x28);
data_out(0x00);
comm_out(0x44);
data_out(0x00);
data_out(0x00);
data_out(0xEF);
data_out(0xB0);
data_out(0x04);
data_out(0xEF);
data_out(0x00);
data_out(0x00);
data_out(0x00);
data_out(0x00);
comm_out(0x5A);
data_out(0x00);
comm_out(0x5B);
data_out(0x00);
comm_out(0x58);
data_out(0x56);
comm_out(0x5D);
data_out(0x04);
data_out(0x86);
comm_out(0x4C);
comm_out(0x59);
data_out(0x16);
delay(5);
}
//-----
```

## 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 For 10 cycles	
Vibration test	Endurance test applying vibration to simulate transportation and use.	10-55Hz, 1.5mm 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=330Ω, CS=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](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)