

# NHD-320240WX-CoTFH-V#I041

## Graphic Liquid Crystal Display Module

NHD-	Newhaven Display
320240-	320 x 240 Pixels
WX-	Display Type: Graphic
Co-	Model
T-	White LED Backlight
F-	FSTN (+)
H-	Transflective, 6:00 Optimal View, Wide Temperature
V#-	Built-in Positive Voltage
I041-	IST Driver, w/ Mounting Holes

**RoHS Compliant**

### Newhaven Display International, Inc.

2661 Galvin Ct.

Elgin IL, 60124

Ph: 847-844-8795

Fax: 847-844-8796

[www.newhavendisplay.com](http://www.newhavendisplay.com)

[nhtech@newhavendisplay.com](mailto:nhtech@newhavendisplay.com)

[nhsales@newhavendisplay.com](mailto:nhsales@newhavendisplay.com)

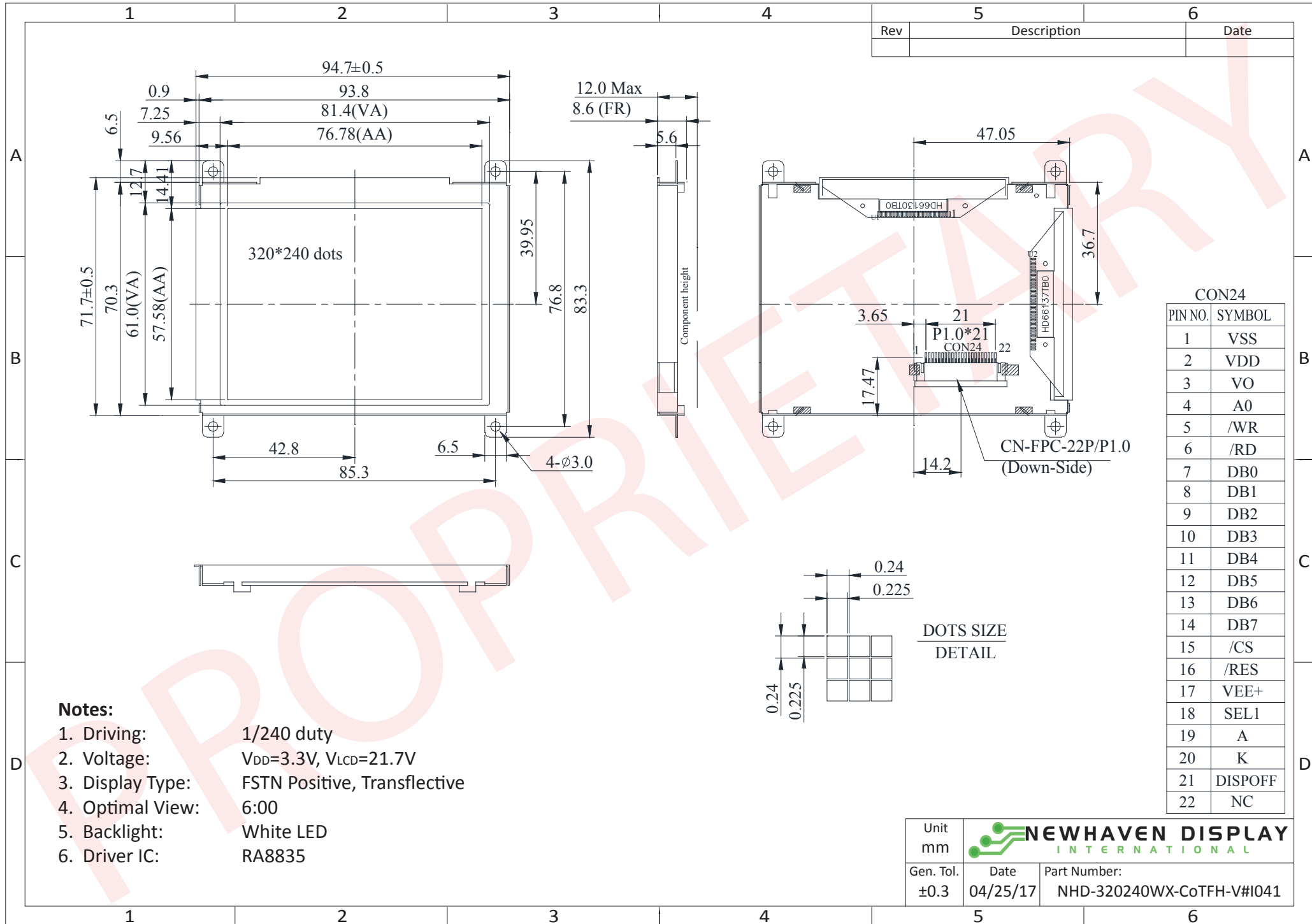
## Document Revision History

Revision	Date	Description	Changed by
0	6/7/2007	Initial Release	-
1	4/23/2010	User guide reformat	MC
2	5/25/2010	Contrast revised	BE
3	6/3/2010	Backlight Supply Current updated	MC
4	2/3/2011	Pin description/block diagram updated	AK
5	2/4/2011	Drawing/pin description/block diagram updated	AK
6	9/21/2012	Drawing/electrical and optical characteristics/block diagram/table of commands updated	JN
7	10/8/2013	Mechanical Drawing, Pin Description, Wiring Diagram, Added Jumper Selection	ML
8	9/18/2015	Electrical Characteristics, Mechanical Drawing, Response Times Updated	SB
9	6/1/16	Mechanical Drawing, Backlight Current, Pin Description, Quality Info	TM
10	4/25/17	Updated Electrical Characteristics	TM

## Functions and Features

- 320 x 240 pixels
- Built-in RA8835 Controller
- +3.3V power supply
- RoHS Compliant

# Mechanical Drawing



CON24	
PIN NO.	SYMBOL
1	VSS
2	VDD
3	VO
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	/RES
17	VEE+
18	SEL1
19	A
20	K
21	DISPOFF
22	NC

- Notes:**
- Driving: 1/240 duty
  - Voltage: V<sub>DD</sub>=3.3V, V<sub>LCD</sub>=21.7V
  - Display Type: FSTN Positive, Transflective
  - Optimal View: 6:00
  - Backlight: White LED
  - Driver IC: RA8835

Unit mm

**NEWHAVEN DISPLAY**  
INTERNATIONAL

Gen. Tol. ±0.3    Date 04/25/17    Part Number: NHD-320240WX-CoTFH-V#I041

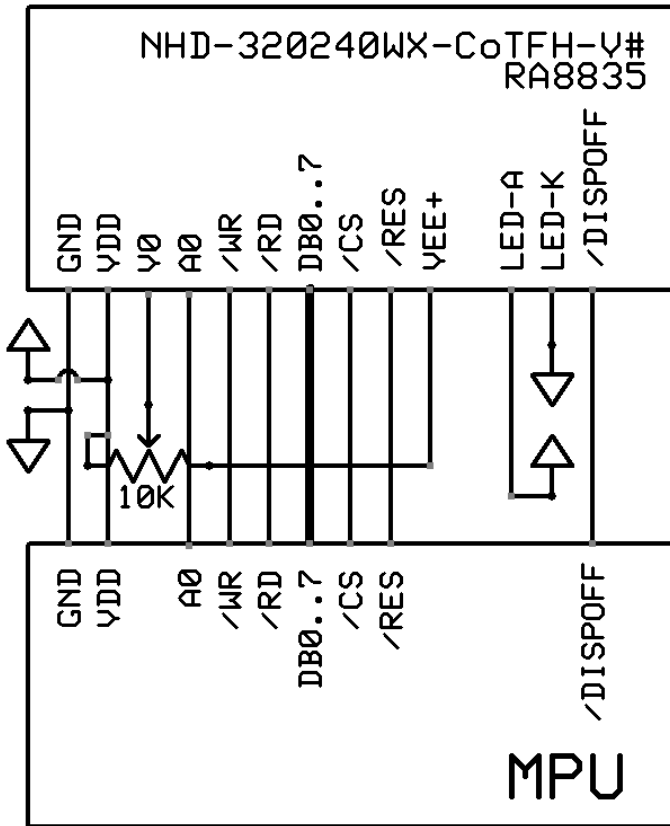
## Pin Description

Pin No.	Symbol	External Connection	Function Description
1	GND	Power Supply	Ground
2	VDD	Power Supply	Supply Voltage for LCD and Logic (+3.3V)
3	V0	Adj Power Supply	Supply Voltage for contrast (approx. (+21.7V))
4	A0	MPU	Register Select signal: '1' = Command, '0' = Data
5	/WR R/W	MPU	8080: Active LOW Write signal 6800: Read/Write select signal: '1' = Read, '0' = Write
6	/RD E	MPU	8080: Active LOW Read signal 6800: Operation Enable signal; Falling edge triggered
7-14	DB0-DB7	MPU	8-bit bi-directional data bus
15	/CS	MPU	Active LOW Chip Select signal
16	/RES	MPU	Active LOW Reset signal
17	VEE+	Power Supply	Positive voltage output (+26V)
18	SEL1	NC	No Connect (selected by on-board jumper JSEL)
19	LED-A	Power Supply	Backlight Anode (+3.5V)
20	LED-K	Power Supply	Backlight Cathode (Ground)
21	/DISPOFF	Power Supply	Active LOW Display OFF signal
22	NC	-	No Connect

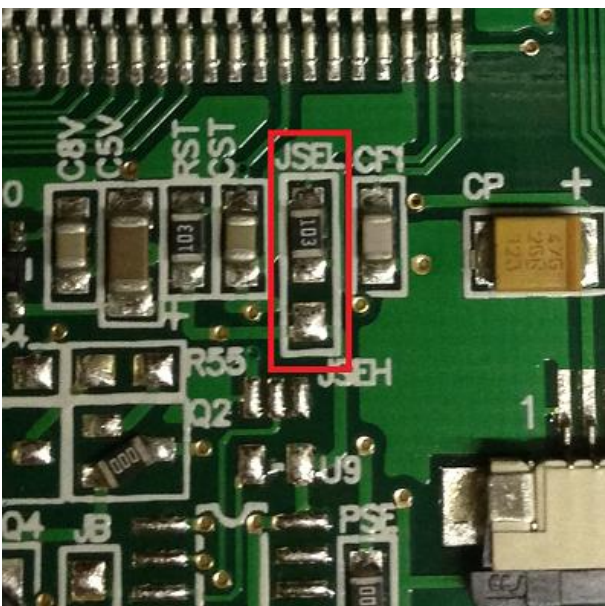
**Recommended LCD connector:** 22 pin, 1.0mm pitch FFC Connector

**Backlight connector:** On LCD Connector      **Mates with:** ---

## Wiring Diagram



## Jumper Selection



JSEL = 8080 mode (default)

JSEH = 6800 mode

## 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>	-	3.0	3.3	3.6	V
Supply Current	I <sub>DD</sub>	V <sub>DD</sub> =3.3V T <sub>a</sub> =25°C	-	33.0	66	mA
Supply for LCD (contrast)	V <sub>LCD</sub>		21.1	21.7	22.3	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>	-	GND	-	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>	-	GND	-	0.4	V
Backlight Supply Voltage	V <sub>LED</sub>	-	3.4	3.5	3.6	V
Backlight Supply Current	I <sub>LED</sub>	V <sub>LED</sub> =3.5V	72	82	120	mA

\*The LED of the backlight is driven by current drain; drive voltage is for reference only. Drive voltage must be selected to ensure backlight current drain is below MAX level stated.

## 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	Tr	-	-	200	300	ms
	Fall	Tf	-	-	250	350	ms

## Controller Information

Built-in RA8835 controller.

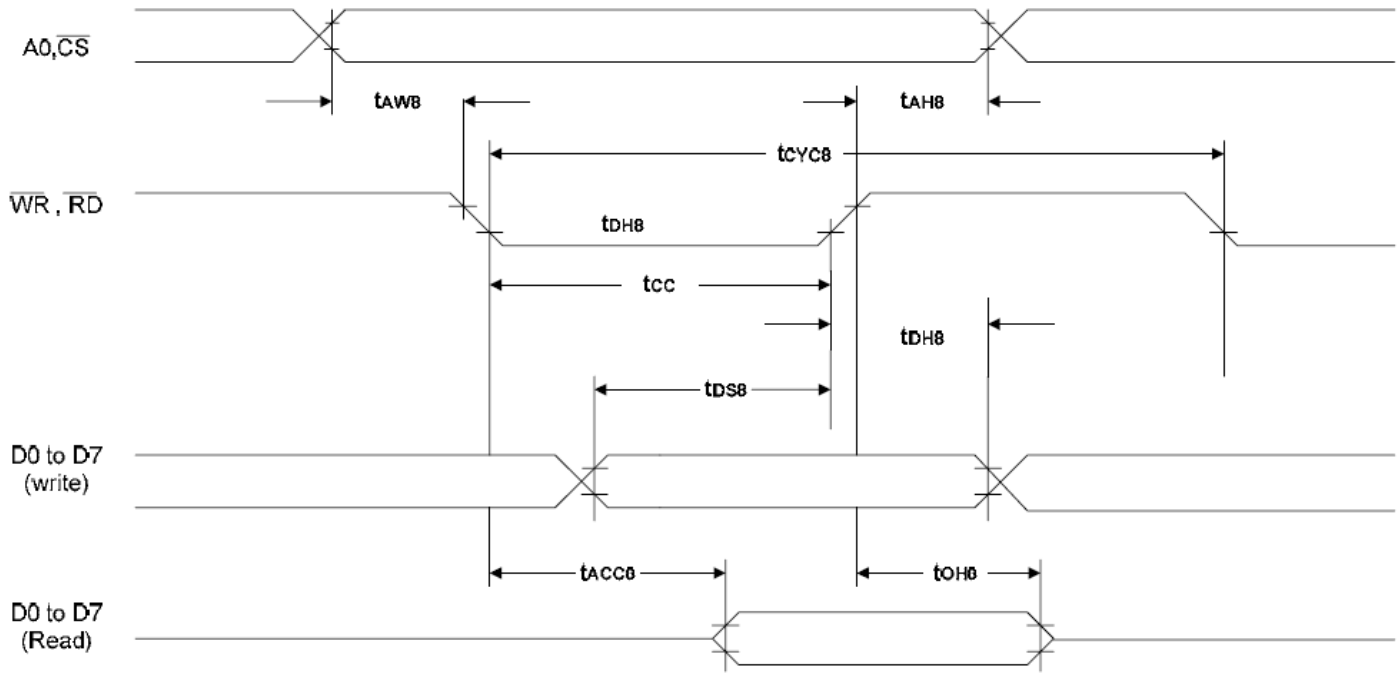
Please download specification at [http://www.newhavendisplay.com/app\\_notes/RA8835.pdf](http://www.newhavendisplay.com/app_notes/RA8835.pdf)

## Table of Commands

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	6-2-1
	<b>SLEEP IN</b>	1	0	1	0	1	0	1	0	0	1	1	53	Enter standby mode	0	6-2-2
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	6-3-1
	<b>SCROLL</b>	1	0	1	0	1	0	0	0	1	0	0	44	Set display start address and display regions	10	6-3-2
	<b>CSRFORM</b>	1	0	1	0	1	0	1	1	1	0	1	5D	Set cursor type	2	6-3-3
	<b>CGRAM ADR</b>	1	0	1	0	1	0	1	1	1	0	0	5C	Set start address of character generator RAM	2	6-3-6
	<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	6-3-4
	<b>HDOT SCR</b>	1	0	1	0	1	0	1	1	0	1	0	5A	Set horizontal scroll position	1	6-3-7
	<b>OVLAY</b>	1	0	1	0	1	0	1	1	0	1	1	5B	Set display overlay format	1	6-3-5
Drawing Control	<b>CSRW</b>	1	0	1	0	1	0	0	0	1	1	0	46	Set cursor address	2	6-4-1
	<b>CSRR</b>	1	0	1	0	1	0	0	0	1	1	1	47	Read cursor address	2	6-4-2
Memory Control	<b>MWRITE</b>	1	0	1	0	1	0	0	0	0	1	0	42	Write to display memory	—	6-5-1
	<b>MREAD</b>	1	0	1	0	1	0	0	0	0	1	1	43	Read from display memory	—	6-5-2

# Timing Characteristics

## 8080 Family Interface Timing



Signal	Symbol	Parameter	$V_{DD} = 4.5 \text{ to } 5.5V$		$V_{DD} = 2.7 \text{ to } 4.5V$		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:

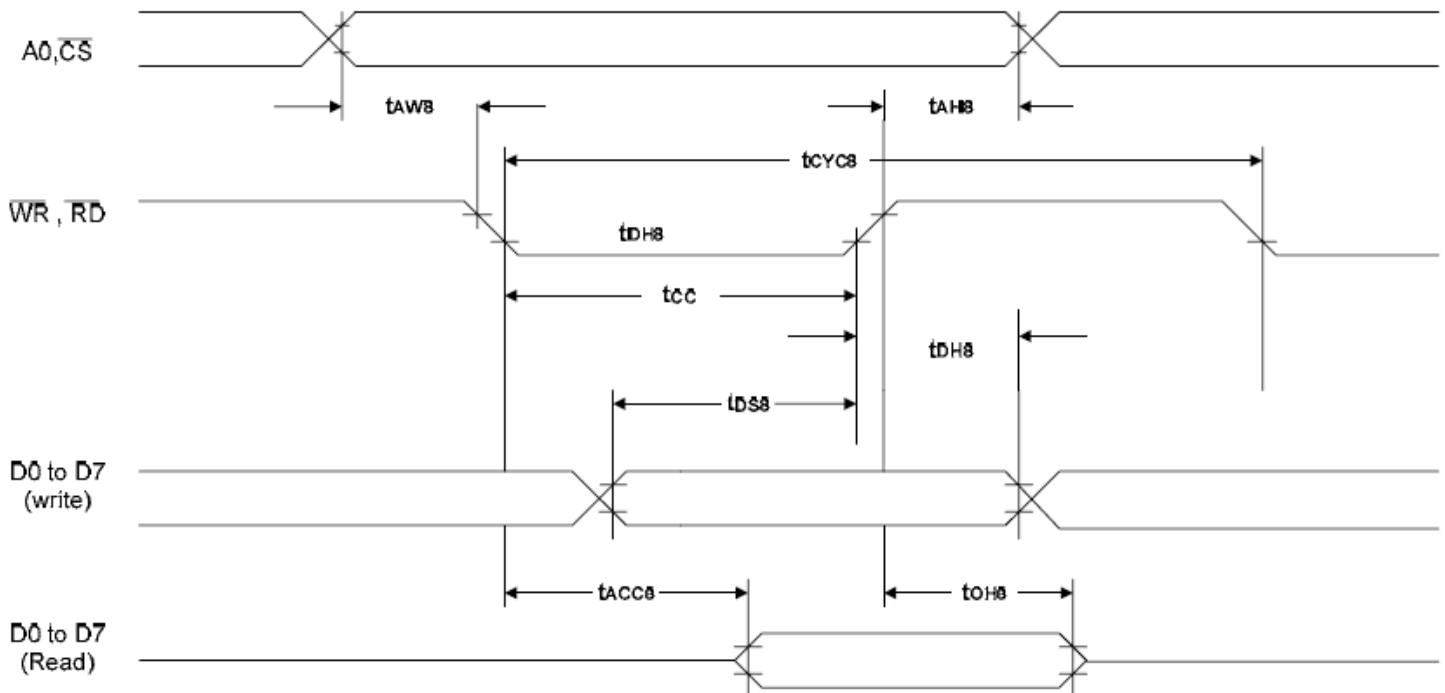
$$t_{CYC8} = 2t_C + t_{CC} + t_{CEA} + 75 > t_{ACV} + 245$$

For all other commands:

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



## 6800 Family Interface Timing



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, $\overline{CS}$ , 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 Code

```
//-----  
#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 8-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=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

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