

Product Specification

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 Optimal View, Wide Temperature
VZ#	Built-in Negative Voltage

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Additional Resources

- **Support Forum:** <https://support.newhavendisplay.com/hc/en-us/community/topics>
- **GitHub:** <https://github.com/newhavendisplay>
- **Example Code:** <https://support.newhavendisplay.com/hc/en-us/categories/4409527834135-Example-Code/>
- **Knowledge Center:** https://www.newhavendisplay.com/knowledge_center.html
- **Quality Center:** https://www.newhavendisplay.com/quality_center.html
- **Precautions for using LCDs/LCMs:** <https://www.newhavendisplay.com/specs/precautions.pdf>
- **Warranty / Terms & Conditions:** <https://www.newhavendisplay.com/terms.html>



Document Revision History

Revision	Date	Description	Changed By
0	06/07/2007	Initial Release	-
1	04/15/2010	User guide reformat	MC
2	04/27/2016	Initialization code update, datasheet reformat	TM
3	11/01/2016	Updated Electrical Characteristics	TM
4	11/13/2017	Supply Current, Backlight Characteristics & Mechanical Drawing Updated	SB
5	10/16/2019	Datasheet Reformat, Updated Pinout	AS
6	10/30/2023	Mechanical Drawing Updated	KL
7	06/10/2024	Mechanical Drawing Updated	KL

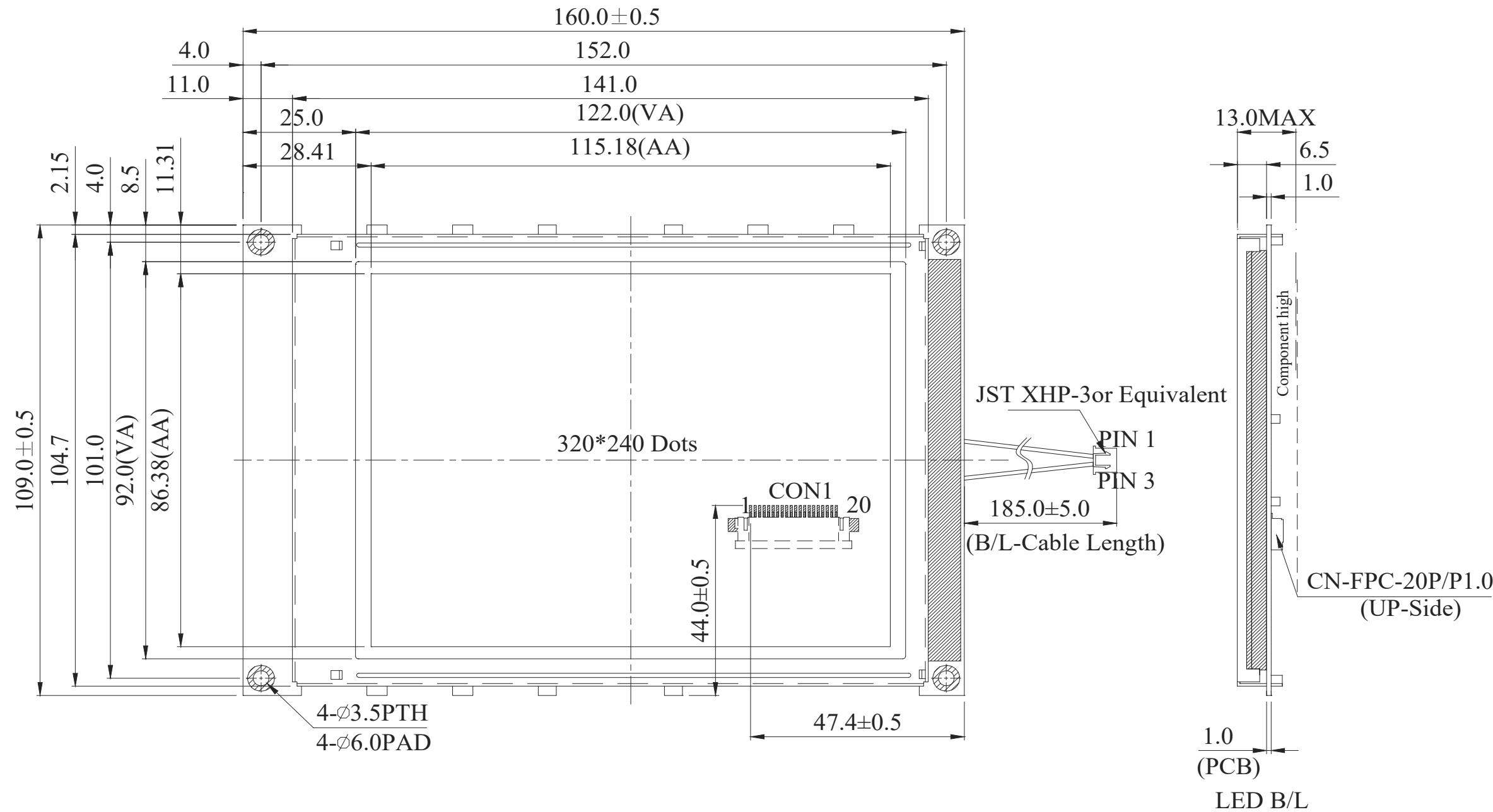
Mechanical Drawing

Newhaven Display

NHD-320240WG-BoTFH-VZ#

Date Code

Part Label (type/format may vary)



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	NC
19	FG
20	NC

Product Description: 320x240 Graphic LCD

1. Driver IC: RA8835
2. Driving Mode: 1/240 Duty
3. Interface: 6800/8080 Parallel
4. Power Requirement: 5.0V LCD
5. Optical Features: FSTN (+), Transflective, 6:00 View, White Backlight
6. Recommended FFC Connector: 20pin 1.0mm pitch

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-320240WG-BoTFH-VZ#

Revision:

-

Drawn By: K. Lewis

Drawn Date: 06/10/2024

Approved By: K. Lewis

Approved Date: 06/10/2024

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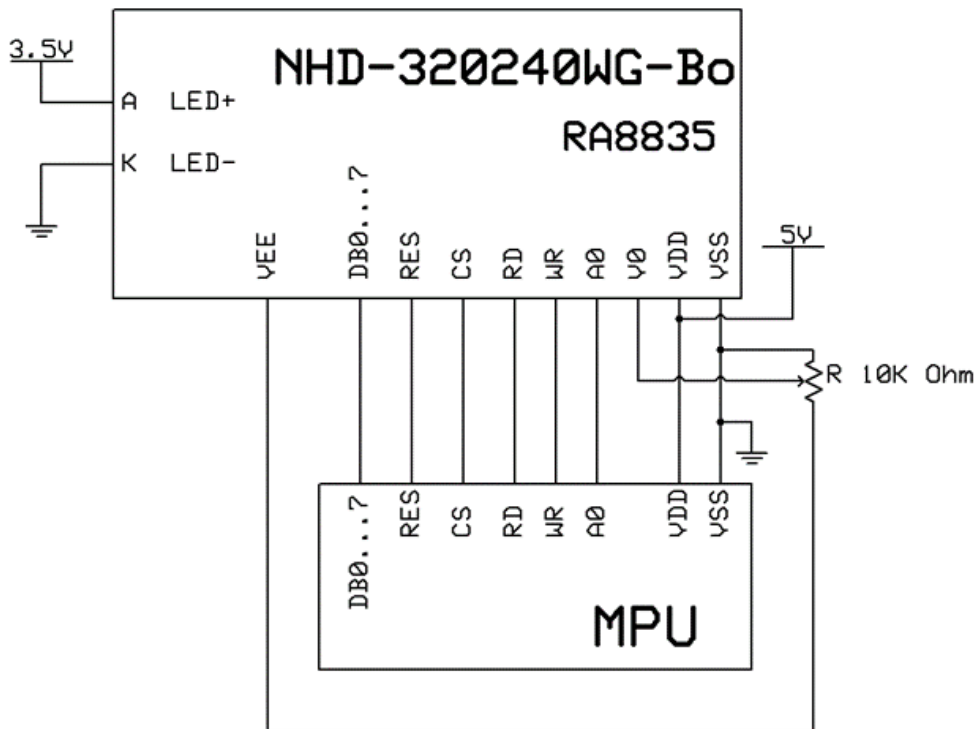
Pin Description

Pin No.	Symbol	External Connection	Function Description
1	V _{SS}	Power Supply	Ground
2	V _{DD}	Power Supply	Supply Voltage for logic (+5.0V)
3	V ₀	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

Wiring Diagram



Electrical Characteristics

Item	Symbol	Condition	Min.	Typ.	Max.	Unit
Operating Temperature Range	T _{OP}	Absolute Max	-20	-	+70	°C
Storage Temperature Range	T _{ST}	Absolute Max	-30	-	+80	°C
Supply Voltage	V _{DD}	-	4.5	5.0	5.5	V
Supply Current	I _{DD}	T _{OP} =25°C, V _{DD} =5.0V	35	65	110	mA
Supply for LCD (contrast)	V _{LCD}		23.0	23.6	24.2	V
"H" Level input	V _{IH}	-	0.5 * V _{DD}	-	V _{DD}	V
"L" Level input	V _{IL}	-	V _{SS}	-	0.2 * V _{DD}	V
"H" Level output	V _{OH}	-	V _{DD} - 0.4	-	V _{DD}	V
"L" Level output	V _{OL}	-	V _{SS}	-	V _{SS} + 0.4	V
Backlight Supply Current	I _{LED}	V _{LED} = 3.5V	-	128	160	mA
Backlight Supply Voltage	V _{LED}	-	3.4	3.5	3.6	V
Backlight Lifetime	-	I _{LED} = 128mA T _{OP} = 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	Tr	T _{OP} = 25°C	-	200	300	ms
	Fall	Tf		-	150	200	ms

Controller Information

Built-in RA8835 Controller: <https://support.newhavendisplay.com/hc/en-us/articles/4414787605399--RA8835>



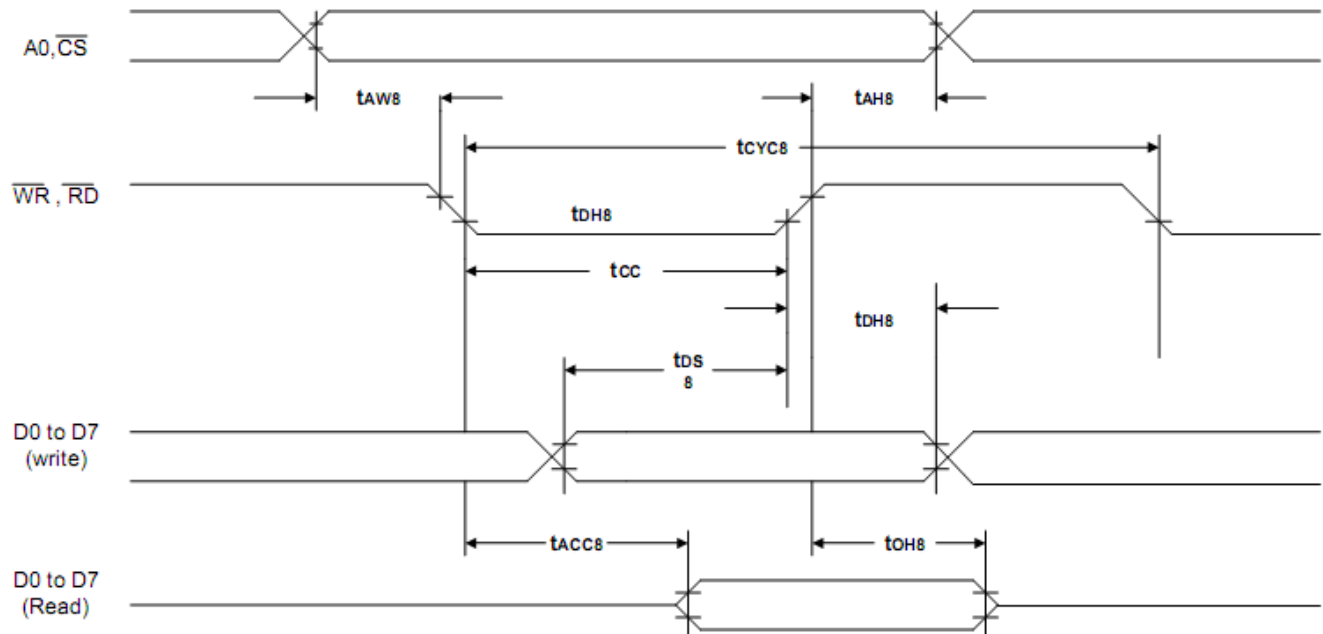
Table of Commands

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	SYSTEM SET	1	0	1	0	1	0	0	0	0	0	0	40	Initialize device and display	8	9-2-1
	SLEEP IN	1	0	1	0	1	0	1	0	0	1	1	53	Enter standby mode	0	9-2-2
Display Control	DISPLAY ON/OFF	1	0	1	0	1	0	1	1	0	0	D	58, 59	Enable and disable display and display flashing	1	9-3-1
	SCROLL	1	0	1	0	1	0	0	0	1	0	0	44	Set display start address and display regions	10	9-3-2
	CSRFORM	1	0	1	0	1	0	1	1	1	0	1	5D	Set cursor type	2	9-3-3
	CGRAM ADR	1	0	1	0	1	0	1	1	1	0	0	5C	Set start address of character generator RAM	2	9-3-6
	CSRDIR	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
	HDOT SCR	1	0	1	0	1	0	1	1	0	1	0	5A	Set horizontal scroll position	1	9-3-7
	OVLAY	1	0	1	0	1	0	1	1	0	1	1	5B	Set display overlay format	1	9-3-5
Drawing Control	CSRW	1	0	1	0	1	0	0	0	1	1	0	46	Set cursor address	2	9-r1
	CSRR	1	0	1	0	1	0	0	0	1	1	1	47	Read cursor address	2	9-4-2
Memory Control	MWRITE	1	0	1	0	1	0	0	0	0	1	0	42	Write to display memory	—	9-5-1
	MREAD	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	

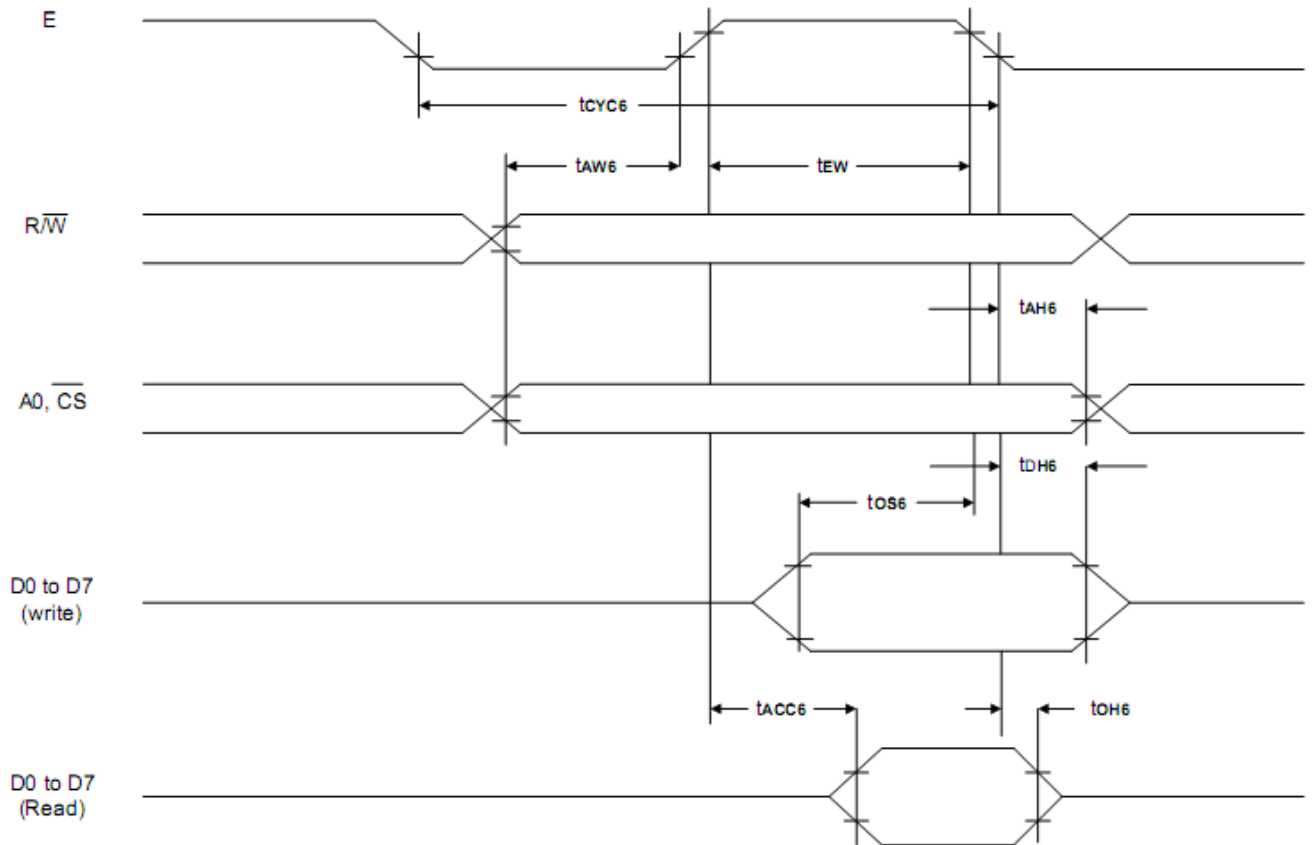
Note: For memory control and system control commands:

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

For all other commands:

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

10-3-2 6800 Family Interface Timing



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

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, $\overline{CS}$, 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:

```
//-----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.