

NHD-320240WG-BxTGH-VZ#-3VR

Graphic Liquid Crystal Display Module

NHD-	Newhaven Display
320240-	320 x 240 Pixels
WG-	Display Type: Graphic
Bx-	Model
T-	White LED Backlight
G-	STN - Gray
H-	Transflective, 6:00 Optimal View, Wide Temperature
VZ#-	Built-in Negative Voltage
3VR-	3.3V V_{DD} , Frame Ground
	RoHS Compliant

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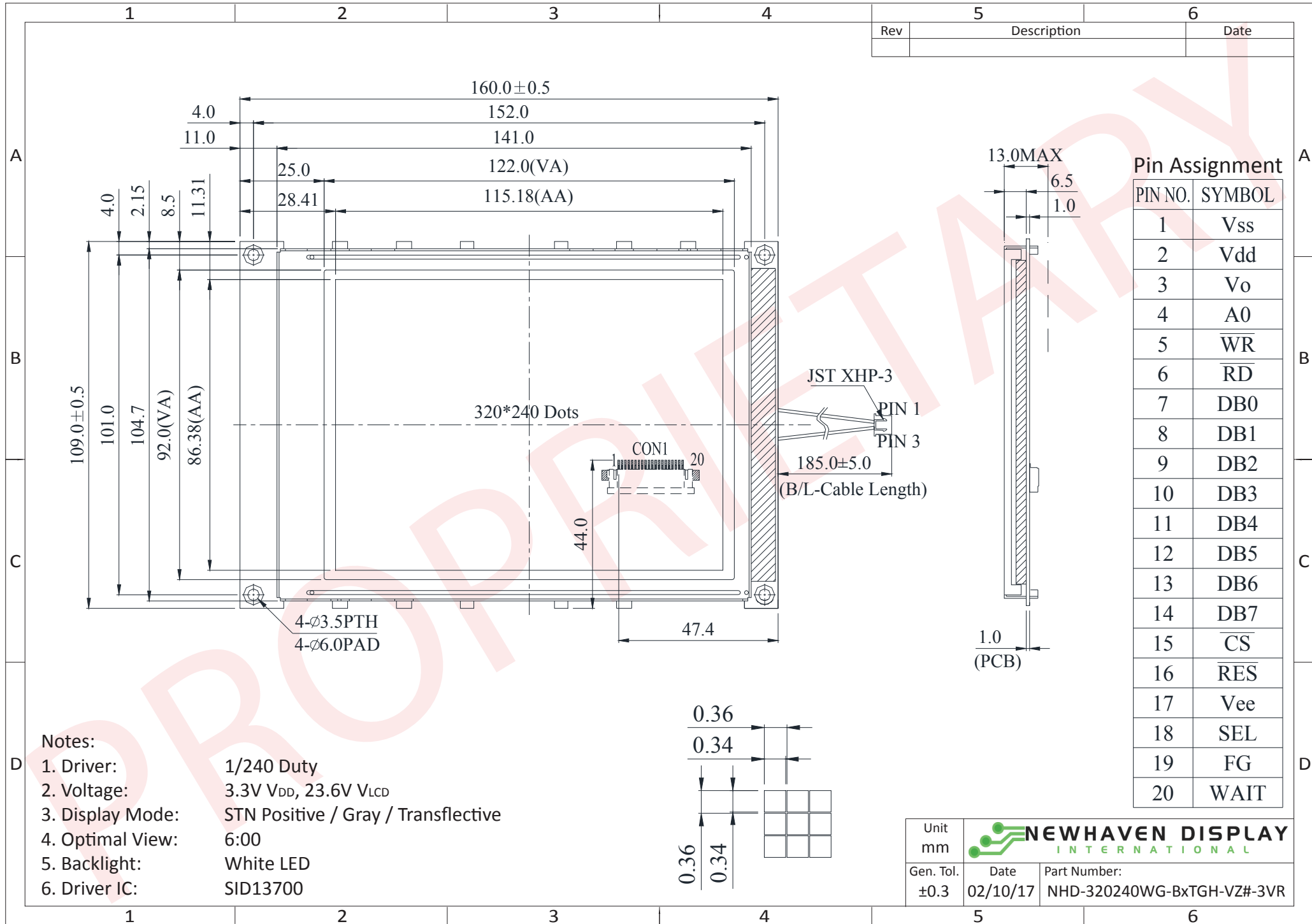
Document Revision History

Revision	Date	Description	Changed by
0	6/7/07	Initial Release	-
1	3/16/10	User guide reformat	MC
2	9/2/10	Mechanical drawing update	MP
3	10/9/2013	Mechanical Drawing, Pin Description, Electrical Characteristics, Timing Characteristics updated Added Jumper Selection	ML
4	6/1/16	Mechanical Drawing, Pin Description, Quality Info, Electrical Characteristics, Optical Characteristics	TM
5	2/10/17	I _{DD} & I _{LED} Updated	SB

Functions and Features

- 320 x 240 pixels
- Built-in S1D13700 Controller
- +3.3V power supply
- RoHS Compliant

Mechanical Drawing



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Pin Description

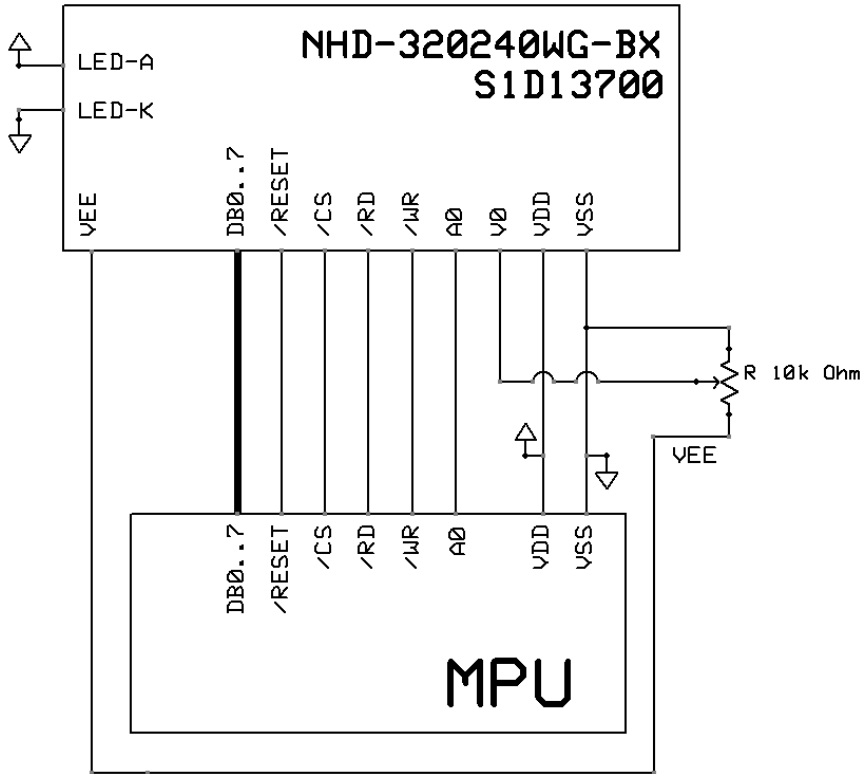
Pin No.	Symbol	External Connection	Function Description
1	V _{SS}	Power Supply	Ground
2	V _{DD}	Power Supply	Supply Voltage for Logic (+3.3V)
3	V ₀	Adj. Power Supply	Supply Voltage for contrast (approx. -18.8V)
4	A0	MPU	Register Select signal. A0=1: Command, A0=0: Data
5	/WR R/W	MPU	8080: Active LOW 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	8-bit bi-directional data bus
15	/CS	MPU	Active LOW Chip Select signal
16	/RESET	MPU	Active LOW Reset signal
17	VEE	Power Supply	Negative voltage output (-25V)
18	NC	-	No Connect
19	NC	-	No Connect
20	NC	-	No Connect

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

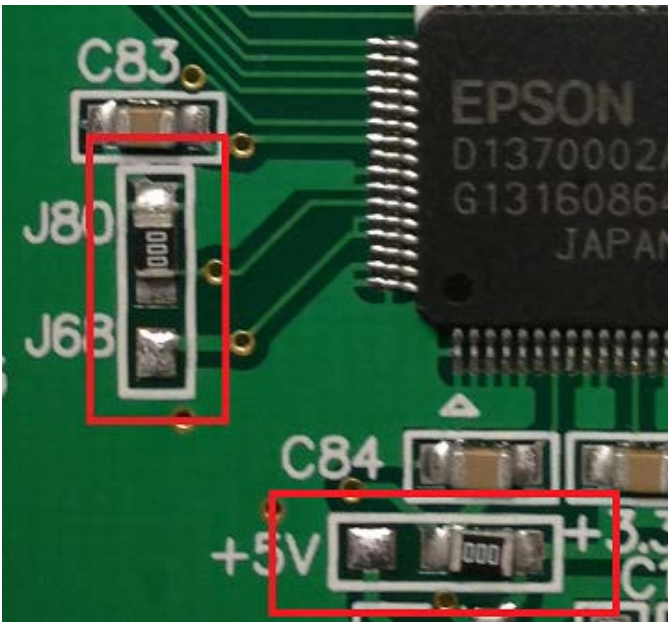
Backlight connector: JST p/n: XHP-3

Mates with: JST p/n: B 3B-XH-A

Wiring Diagram



Jumper Selection



Note: This display is pre-configured for 3.3V and 8080 mode.

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}	-	3.0	3.3	3.6	V
Supply Current	I_{DD}	VDD=3.3V Ta=25°C	50	100	150	mA
Supply for LCD (contrast)	V_{LCD}		23.0	23.6	24.2	V
"H" Level input	V_{IH}	-	2.0	-	V_{DD}	V
"L" Level input	V_{IL}	-	V_{SS}	-	0.8	V
"H" Level output	V_{OH}	-	$V_{DD} - 0.4$	-	V_{DD}	V
"L" Level output	V_{OL}	-	V_{SS}	-	0.4	V
Backlight Supply Voltage	V_{LED}	-	3.4	3.5	3.6	V
Backlight Supply Current	I_{LED}	VLED=3.5V	40	128	160	mA

Optical Characteristics

Item	Symbol	Condition	Min.	Typ.	Max.	Unit
Optimal Viewing Angles	Top	$Cr \geq 3$	-	20	-	°
	Bottom		-	40	-	°
	Left		-	30	-	°
	Right		-	30	-	°
Contrast Ratio	Cr	-	-	3	-	-
Response Time	Rise	Tr	-	200	300	ms
	Fall	Tf	-	250	350	ms

Controller Information

Built-in S1D13700 controller.

Please download specification at http://www.newhavendisplay.com/app_notes/S1D13700.pdf

Table of Commands

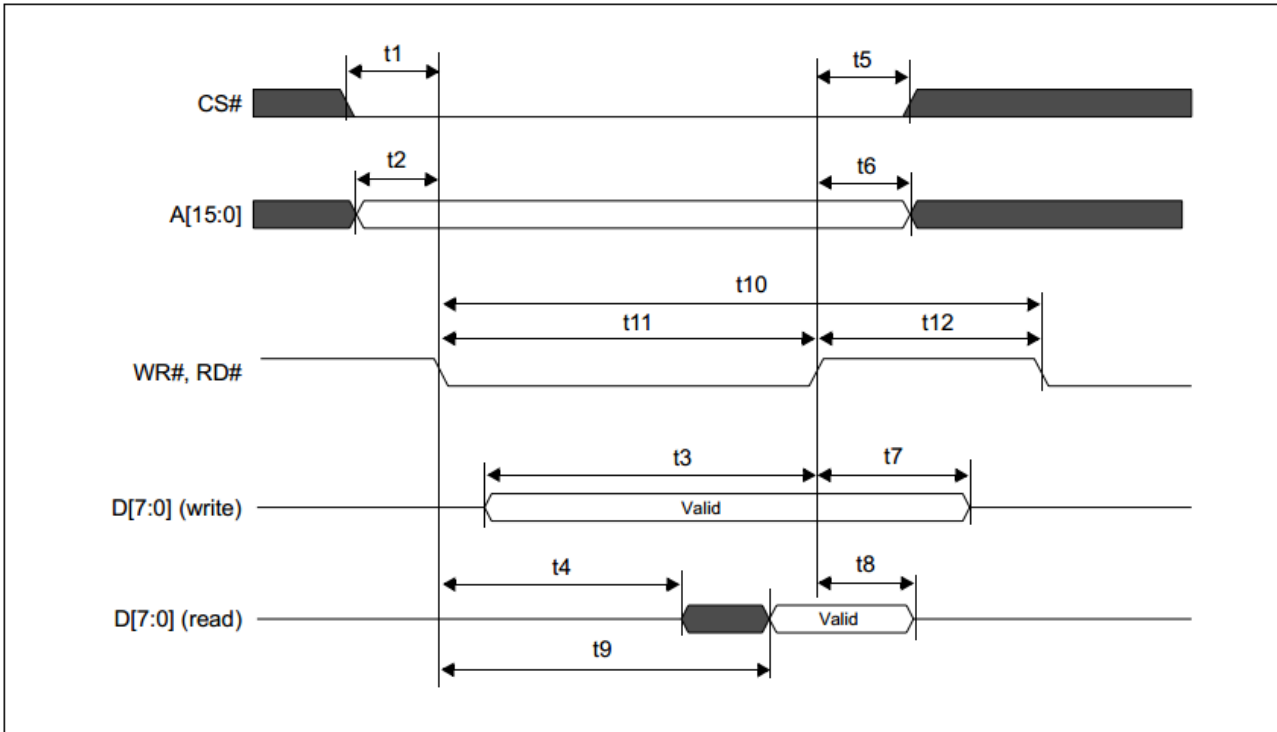
REG[01h] Horizontal Character Size Register							
Address = 8001h Default = 00h							Read/Write
MOD	n/a			Horizontal Character Size bits 3-0			
7	6	5	4	3	2	1	0
REG[02h] Vertical Character Size Register							
Address = 8002h Default = 00h							Read/Write
n/a			Vertical Character Size bits 3-0				
7	6	5	4	3	2	1	0
REG[03h] Character Bytes Per Row Register							
Address = 8003h Default = 00h							Read/Write
Character Bytes Per Row bits 7-0							
7	6	5	4	3	2	1	0
REG[04h] Total Character Bytes Per Row Register							
Address = 8004h Default = 00h							Read/Write
Total Character Bytes Per Row bits 7-0							
7	6	5	4	3	2	1	0
REG[05h] Frame Height Register							
Address = 8005h Default = 00h							Read/Write
Frame Height bits 7-0							
7	6	5	4	3	2	1	0
REG[06h] Horizontal Address Range Register 0							
Address = 8006h Default = 00h							Read/Write
Horizontal Address Range bits 7-0							
7	6	5	4	3	2	1	0
REG[07h] Horizontal Address Range Register 1							
Address = 8007h Default = 00h							Read/Write
Horizontal Address Range bits 15-8							
7	6	5	4	3	2	1	0
REG[08h] Power Save Mode Register							
Address = 8008h Default = 01h							Read/Write
n/a						Power Save Mode Enable	
7	6	5	4	3	2	1	0
REG[09h] Display Enable Register							
Address = 8009h Default = 00h							Read/Write
n/a						Display Enable	
7	6	5	4	3	2	1	0
REG[0Ah] Display Attribute Register							
Address = 800Ah Default = 00h							Read/Write
SAD3 Attribute bits 1-0		SAD2 Attribute bits 1-0		SAD1 Attribute bits 1-0		Cursor Attribute bits 1-0	
7	6	5	4	3	2	1	0
REG[0Bh] Screen Block 1 Start Address Register 0							
Address = 800Bh Default = 00h							Read/Write
Screen Block 1 Start Address bits 7-0 (LSB)							
7	6	5	4	3	2	1	0
REG[0Ch] Screen Block 1 Start Address Register 1							
Address = 800Ch Default = 00h							Read/Write
Screen Block 1 Start Address bits 15-8 (MSB)							
7	6	5	4	3	2	1	0
REG[0Dh] Screen Block 1 Size Register							
Address = 800Dh Default = 00h							Read/Write
Screen Block 1 Size bits 7-0							
7	6	5	4	3	2	1	0

REG[0Eh] Screen Block 2 Start Address Register 0								Read/Write
Address = 800Eh Default = 00h								
Screen Block 2 Start Address bits 7-0 (LSB)								
7	6	5	4	3	2	1	0	
REG[0Fh] Screen Block 2 Start Address Register 1								Read/Write
Address = 800Fh Default = 00h								
Screen Block 2 Start Address bits 15-8 (MSB)								
7	6	5	4	3	2	1	0	
REG[10h] Screen Block 2 Size Register								Read/Write
Address = 8010h Default = 00h								
Screen Block 2 Size bits 7-0								
7	6	5	4	3	2	1	0	
REG[11h] Screen Block 3 Start Address Register 0								Read/Write
Address = 8011h Default = 00h								
Screen Block 3 Start Address bits 7-0 (LSB)								
7	6	5	4	3	2	1	0	
REG[12h] Screen Block 3 Start Address Register 1								Read/Write
Address = 8012h Default = 00h								
Screen Block 3 Start Address bits 15-8 (MSB)								
7	6	5	4	3	2	1	0	
REG[13h] Screen Block 4 Start Address Register 0								Read/Write
Address = 8013h Default = 00h								
Screen Block 4 Start Address bits 7-0 (LSB)								
7	6	5	4	3	2	1	0	
REG[14h] Screen Block 4 Start Address Register 1								Read/Write
Address = 8014h Default = 00h								
Screen Block 4 Start Address bits 15-8 (MSB)								
7	6	5	4	3	2	1	0	
REG[15h] Cursor Width Register								Read/Write
Address = 8015h Default = 00h								
n/a				Cursor Width bits 3-0				
7	6	5	4	3	2	1	0	
REG[16h] Cursor Height Register								Read/Write
Address = 8016h Default = 00h								
Cursor Mode	n/a				Cursor Height bits 3-0			
7	6	5	4	3	2	1	0	
REG[17h] Cursor Shift Direction Register								Read/Write
Address = 8017h Default = 00h								
n/a					Cursor Shift Direction bits 1-0			
7	6	5	4	3	2	1	0	
REG[18h] Overlay Register								Read/Write
Address = 8018h Default = 00h								
n/a			3 Layer Overlay Select	Screen Block 3 Display Mode	Screen Block 1 Display Mode	Layer Composition Method bits 1-0		
7	6	5	4	3	2	1	0	
REG[19h] Character Generator RAM Start Address Register 0								Read/Write
Address = 8019h Default = 00h								
CGRAM Start Address bits 7-0 (LSB)								
7	6	5	4	3	2	1	0	
REG[1Ah] Character Generator RAM Start Address Register 1								Read/Write
Address = 801Ah Default = 00h								
CGRAM Start Address bits 15-8 (MSB)								
7	6	5	4	3	2	1	0	
REG[1Bh] Horizontal Pixel Scroll Register								Read/Write
Address = 801Bh Default = 00h								
n/a				Horizontal Pixel Scroll bits 2-0				
7	6	5	4	3	2	1	0	

REG[1Ch] Cursor Write Register 0								Write Only
Address = 801Ch Default = 00h								
Cursor Write bits 7-0 (LSB)								
7	6	5	4	3	2	1	0	
REG[1Dh] Cursor Write Register 1								Write Only
Address = 801Dh Default = 00h								
Cursor Write bits 15-8 (MSB)								
7	6	5	4	3	2	1	0	
REG[1Eh] Cursor Read Register 0								Read Only
Address = 801Eh Default = 00h								
Cursor Read bits 7-0 (LSB)								
7	6	5	4	3	2	1	0	
REG[1Fh] Cursor Read Register 1								Read Only
Address = 801Fh Default = 00h								
Cursor Read bits 15-8 (MSB)								
7	6	5	4	3	2	1	0	
REG[20h] Bit-Per-Pixel Select Register								Read/Write
Address = 8020h Default = 00h								
n/a						Bit-Per-Pixel Select bits 1-0		
7	6	5	4	3	2	1	0	

Timing Characteristics

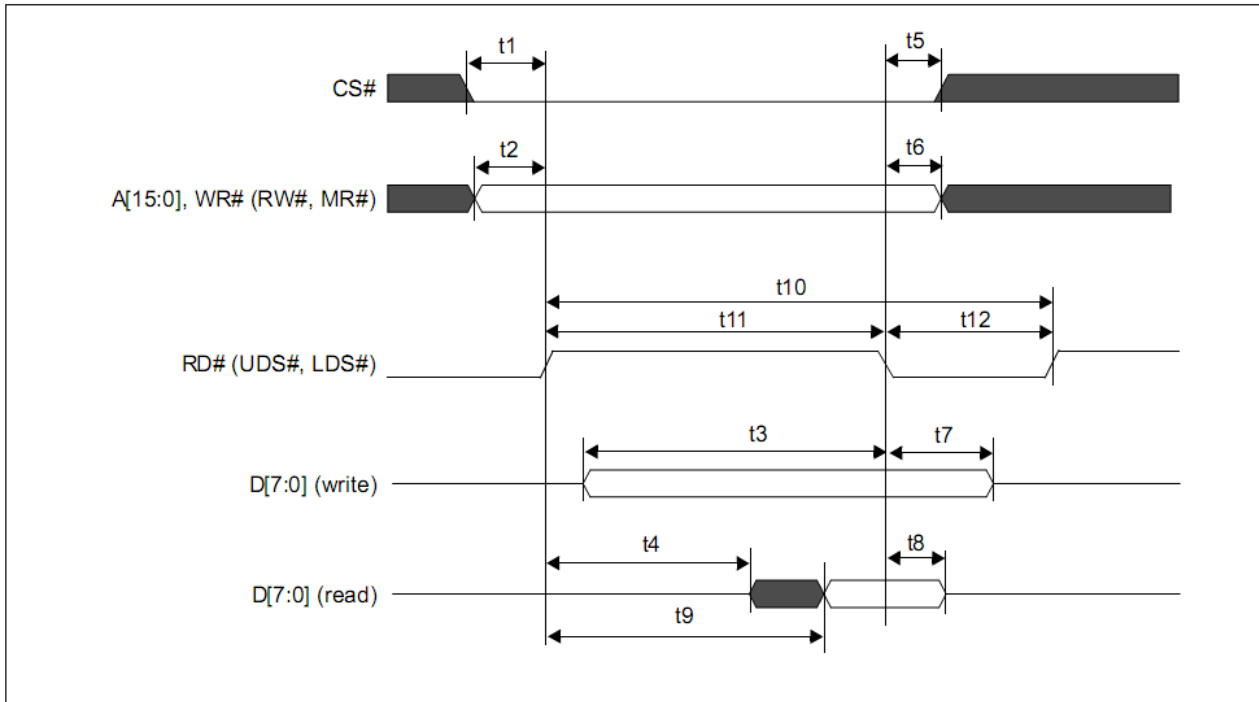
8080 Family Bus Interface Timing



Symbol	Parameter	3.3 Volt		5.0 Volt		Units
		Min	Max	Min	Max	
t1	CS# setup time	5	—	5	—	ns
t2	A[15:0] setup time	5	—	5	—	ns
t3	D[7:0] setup time to WR# rising edge (write cycle)	Note 2	—	Note 2	—	ns
t4	RD# falling edge to D[7:0] driven (read cycle)	3	—	3	—	ns
t5	CS# hold time	7	—	7	—	ns
t6	A[15:0] hold time	7	—	7	—	ns
t7	D[7:0] hold time from WR# rising edge (write cycle)	5	—	5	—	ns
t8	D[7:0] hold time from RD# rising edge (read cycle)	3	14	3	14	ns
t9	RD# falling edge to valid Data (read cycle)	—	Note 3	—	Note 3	ns
t10	RD#, WR# cycle time	Note 4	—	Note 4	—	ns
t11	RD#, WR# pulse active time	5	—	5	—	Ts
t12	RD#, WR# pulse inactive time	Note 5	—	Note 5	—	ns

1. T_s = System clock period
2. t_{3min} = $2T_s + 5$
3. t_{9max} = $4T_s + 18$ (for 3.3V)
= $4T_s + 20$ (for 5.0V)
4. t_{10min} = $6T_s$ (for a read cycle followed by a read or write cycle)
= $7T_s + 2$ (for a write cycle followed by a write cycle)
= $10T_s + 2$ (for a write cycle followed by a read cycle)
5. t_{12min} = $1T_s$ (for a read cycle followed by a read or write cycle)
= $2T_s + 2$ (for a write cycle followed by a write cycle)
= $5T_s + 2$ (for a write cycle followed by a read cycle)

6800 Family Bus Interface Timing



Symbol	Parameter	3.3 Volt		5.0 Volt		Units
		Min	Max	Min	Max	
t1	CS# setup time	5	—	5	—	ns
t2	A[15:0] setup time	5	—	5	—	ns
t3	D[7:0] setup time to RD# falling edge (write cycle)	Note 2	—	Note 2	—	ns
t4	RD# rising edge to D[7:0] driven (read cycle)	3	—	3	—	ns
t5	CS# hold time	7	—	7	—	ns
t6	A[15:0] hold time	7	—	7	—	ns
t7	D[7:0] hold time from RD# falling edge (write cycle)	5	—	5	—	ns
t8	D[7:0] hold time from RD# falling edge (read cycle)	2	55	2	55	ns
t9	RD# rising edge to valid Data	—	Note 3	—	Note 3	ns
t10	RD# cycle time	Note 4	—	Note 4	—	ns
t11	RD# pulse active time	5	—	5	—	Ts
t12	RD# pulse inactive time	Note 5	—	Note 5	—	ns

1. T_s = System clock period
2. $t_{3min} = 2T_s + 5$
3. $t_{9max} = 4T_s + 18$ (for 3.3V)
 $= 4T_s + 20$ (for 5.0V)
4. $t_{10min} = 6T_s$ (for a read cycle followed by a read or write cycle)
 $= 7T_s + 2$ (for a write cycle followed by a write cycle)
 $= 10T_s + 2$ (for a write cycle followed by a read cycle)
5. $t_{12min} = 1T_s$ (for a read cycle followed by a read or write cycle)
 $= 2T_s + 2$ (for a write cycle followed by a write cycle)
 $= 5T_s + 2$ (for a write cycle followed by a read cycle)

Example Initialization Code

```
//-----  
Sub Writecom  
  Set P3.0  
  P1 = A  
  Reset P3.1  
  Reset P3.7  
  Set P3.4  
  Reset P3.4  
  Set P3.7  
  Set P3.1  
End Sub  
  
Sub Writedata  
  Reset P3.0  
  P1 = A  
  Reset P3.1  
  Reset P3.7  
  Set P3.4  
  Reset P3.4  
  Set P3.7  
  Set P3.1  
End Sub  
  
//-----  
Sub Init  
  Set P3.2  
  Reset P3.6  
  Waitms 10  
  Set P3.6  
  Waitms 100  
  
  A = &H40  
  Call Writecom  
  A = &H30  
  Call Writedata  
  A = &H87  
  Call Writedata  
  A = &H07  
  Call Writedata  
  A = &H27  
  Call Writedata  
  A = &H50  
  Call Writedata  
  A = &HEF  
  Call Writedata  
  A = &H28  
  Call Writedata  
  A = &H00  
  Call Writedata  
  A = &H44  
  Call Writecom  
  A = &H00  
  Call Writedata  
  A = &H00  
  Call Writedata  
  A = &HEF  
  Call Writedata  
  A = &HB0  
  Call Writedata  
  A = &H04  
  Call Writedata  
  
  'A0 = H = Write command  
  'move data to P1  
  'chip select  
  'R/W  
  'E  
  'E  
  'R/W  
  'CS  
  
  'A0 = L = Write data  
  
  'SEL=1 = Motorola 6800 interface  
  'RESET  
  'wait  
  'RESET done  
  'wait  
  
  'system set command  
  'set parameters  
  'horizontal character size=8  
  'vertical character size=8  
  'display addresses per line  
  'total address range per line  
  '240 display lines  
  'virtual address1  
  'virtual address2  
  'scroll  
  'start address1  
  'start address2  
  '240 lines  
  '2nd screen start1  
  '2nd screen start2
```

```

A = &HEF                                '2nd screen 240 lines
Call Writedata
A = &H00                                  '3rd screen address1
Call Writedata
A = &H00                                  '3rd screen address2
Call Writedata
A = &H00                                  '4th screen address1
Call Writedata
A = &H00                                  '4th screen address2
Call Writedata
A = &H5A                                  'hdot scr
Call Writecom
A = &H00                                  'horizontal pixel shift=0
Call Writedata
A = &H5B                                  'overlay
Call Writecom
A = &H00                                  'OR
Call Writedata
A = &H5D                                  'cursor form
Call Writecom
A = &H04                                  '5 pixels
Call Writedata
A = &H86                                  'by 7 pixels
Call Writedata
A = &H4C                                  'cursor direction = right
Call Writecom

Call Clr                                  'clear the screen

A = &H59                                  'disp on/off
Call Writecom
A = &H14                                  'on
Call Writedata
End Sub

```

//-----

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	
Low Temperature Operation	Endurance test applying the electric stress (voltage & current) and the low thermal stress for a long time.	-20°C , 200hrs	1
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, 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.	V _s =±600V(contact),±800V(Air) 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

Warranty Information

See Terms & Conditions at http://www.newhavendisplay.com/index.php?main_page=terms