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NHD-C12864WO-B1TFH#-M

COG (Chip-On-Glass) Liquid Crystal Display Module

NHD-	Newhaven Display
C12864-	128 x 64 pixels
WO-	Display Type: COG
B1-	Model
T-	White LED backlight
F-	FSTN (+)
H-	Transflective, Wide Temp (-20°C ~ +70°C), 6:00 view
#-M-	Mounting Holes
	RoHS Compliant

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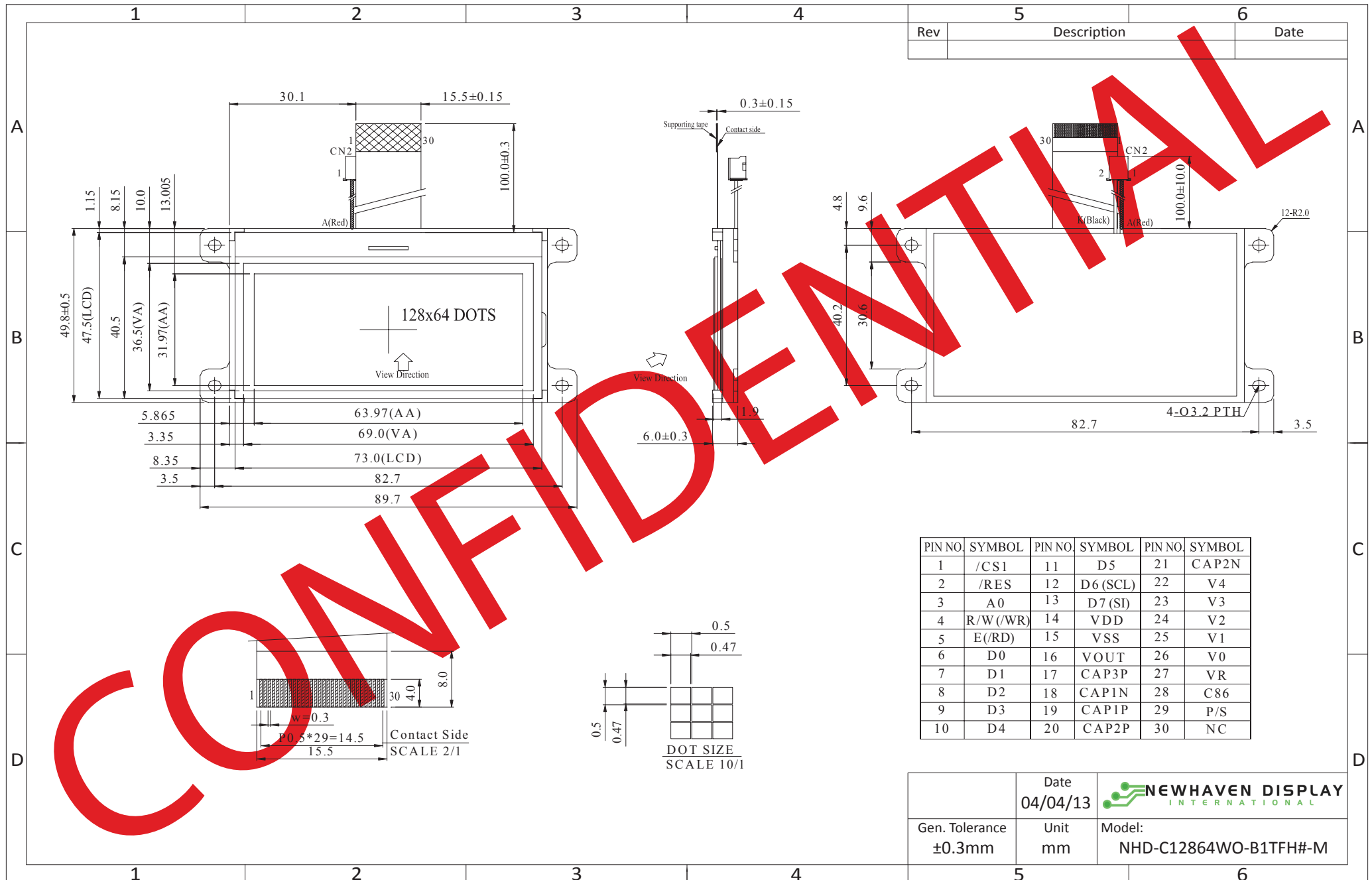
Document Revision History

Revision	Date	Description	Changed by
0	9/1/2008	Initial Release	-
1	11/12/2009	User guide reformat	MC
2	12/14/2009	Block Diagram Update	MC
3	2/12/2010	Added –M to p/n to signify this part has mounting holes	MC
4	3/9/2010	Block diagram updated	BE
5	5/4/2010	Block diagram and pin description	MP
6	5/5/2010	Backlight Connectors updated	BE
7	5/14/2010	Pin description update	MP
8	5/2/2011	Example initialization code updated	AK
9	5/13/2011	Block diagram updated	AK
10	5/19/2011	Block diagram & Pin description updated	AK
11	1/10/2012	Pin description & Controller link updated	AK
12	6/15/2012	Timing characteristics updated	AK
13	4/4/2013	Backlight mating connector, LCD voltage levels updated	AK

Functions and Features

- 128 x 64 pixels
- Built-in ST7565P-G controller
- +3.3V power supply
- 1/65 duty cycle; 1/9 bias
- RoHS Compliant

Mechanical Drawing



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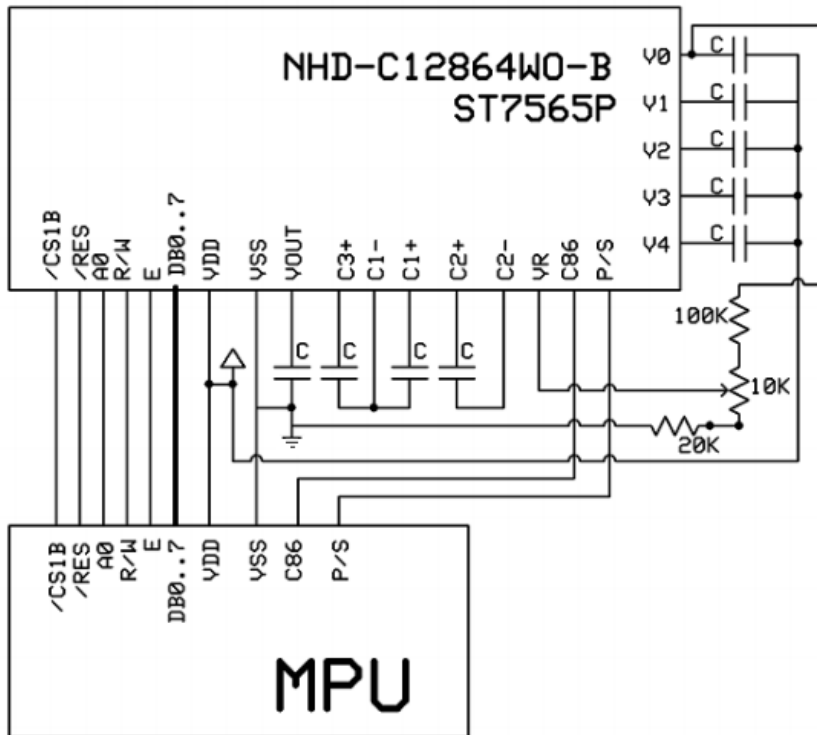
Pin Description and Wiring Diagram

Pin No.	Symbol	External Connection	Function Description
1	/CS1	MPU	Active LOW chip select
2	/RES	MPU	Active LOW Reset signal
3	A0	MPU	Register select signal. 0: instruction; 1: data
4	R/W (/WR)	MPU	Read/write select signal. R/W=1: Read R/W=0: Write
5	E (/RD)	MPU	Operation enable signal. Falling edge triggered.
6-13	DB0~DB7	MPU	In parallel interface: 8-bit-directional data bus In serial interface: DB0~DB5 = VDD or NC D6 = Serial clock D7 = Serial data
14	VDD	Power Supply	Power supply for logic (+3.3V)
15	VSS	Power Supply	Ground
16	VOUT	Power Supply	2.2uF cap to VSS
17	CAP3P	Power Supply	2.2uF cap to CAP1N (pin-18)
18	CAP1N	Power Supply	2.2uF cap to CAP3P (pin-17) and CAP1P (pin-19)
19	CAP1P	Power Supply	2.2uF cap to CAP1N (pin-18)
20	CAP2P	Power Supply	2.2uF cap to CAP2N (pin-21)
21	CAP2N	Power Supply	2.2uF cap to CAP2P (pin-20)
22-26	V4~V0	Power Supply	2.2uF cap to VDD or VSS
27	VR	Adj Power Supply	Wiper of 10kΩ pot (see schematic below)
28	C86	MPU	Select MPU interface pin. C86= H:6800; C86= L:8080
29	P/S	MPU	Parallel/Serail select. PS= H: Parallel; PS= L: Serial
30	NC	-	No connect

Recommended LCD connector: 0.5mm Pitch, 30 pin FFC. Molex p/n: 52892-3095

Backlight connector: A2001H-02P

Mates with: A2001WR-2P, A2001WR-S-2P, A2001WV-2P, A2001WV-S-2P



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		3.0	-	3.3	V
Supply Current	IDD	Ta=25°C, VDD=3.3V	-	0.6	2.0	mA
Supply for LCD (contrast)	VDD-V0	Ta=25°C	9.2	9.45	9.7	V
"H" Level input	Vih		0.8*VDD	-	VDD	V
"L" Level input	Vil		VSS	-	0.2*VDD	V
"H" Level output	Voh		0.8*VDD	-	VDD	V
"L" Level output	Vol		VSS	-	0.2*VDD	V
LED Backlight voltage	VLED		3.4	3.5	3.6	V
LED Backlight current	ILED	VLED=3.5V	61.2	72	100	mA

Optical Characteristics

Item	Symbol	Condition	Min.	Typ.	Max.	Unit
Viewing Angle – Top		CR ≥ 2	-	20	-	°
Viewing Angle – Bottom			-	40	-	°
Viewing Angle – Left			-	40	-	°
Viewing Angle – Right			-	40	-	°
Contrast Ratio	CR		-	5	-	-
Response Time (rise)	Tr		-	100	280	ms
Response Time (fall)	Tf		-	180	330	ms

Controller Information

Built-in ST7565P-G controller

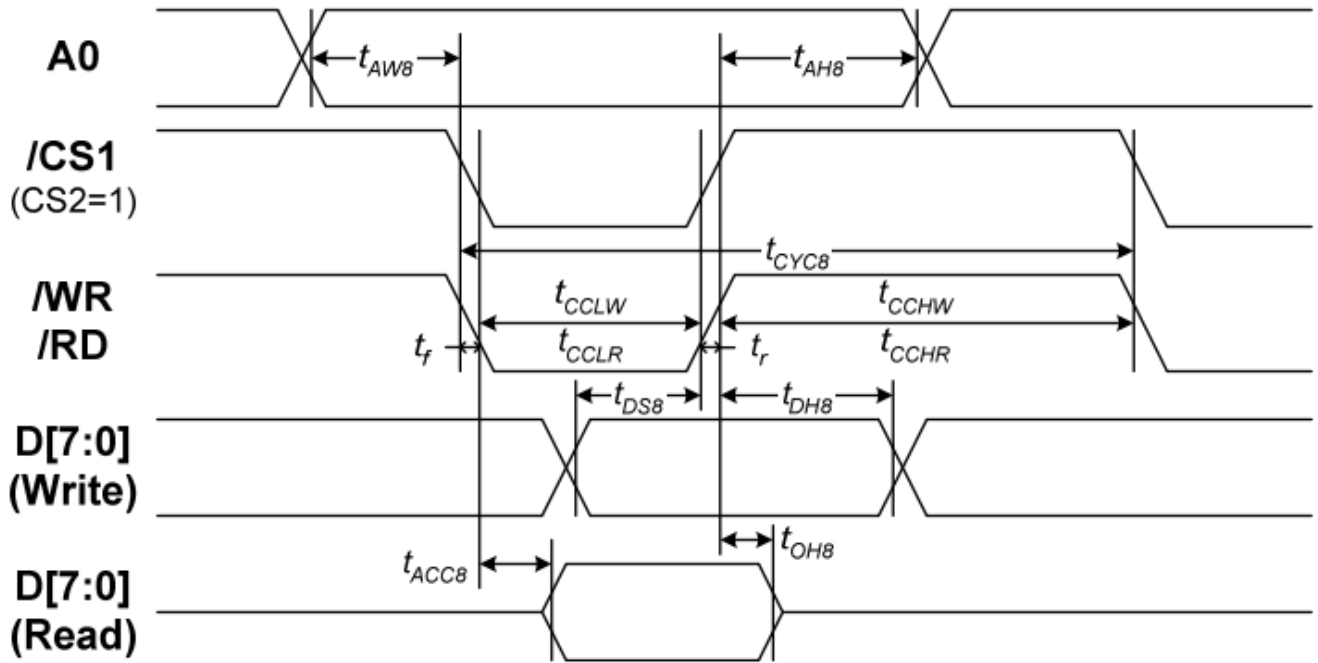
Please download specification at http://www.newhavendisplay.com/app_notes/ST7565P.pdf

Table of Commands

Command	Command Code										Function			
	A0	/RD	/WR	D7	D6	D5	D4	D3	D2	D1		D0		
(1) Display ON/OFF	0	1	0	1	0	1	0	1	1	1	0	1	LCD display ON/OFF 0: OFF, 1: ON	
(2) Display start line set	0	1	0	0	1	Display start address						Sets the display RAM display start line address		
(3) Page address set	0	1	0	1	0	1	1	Page address					Sets the display RAM page address	
(4) Column address set upper bit	0	1	0	0	0	0	1	Most significant column address				Sets the most significant 4 bits of the display RAM column address. Sets the least significant 4 bits of the display RAM column address.		
Column address set lower bit	0	1	0	0	0	0	0	Least significant column address						
(5) Status read	0	0	1	Status				0	0	0	0		Reads the status data	
(6) Display data write	1	1	0	Write data								Writes to the display RAM		
(7) Display data read	1	0	1	Read data								Reads from the display RAM		
(8) ADC select	0	1	0	1	0	1	0	0	0	0	0	0	1	Sets the display RAM address SEG output correspondence 0: normal, 1: reverse
(9) Display normal/reverse	0	1	0	1	0	1	0	0	1	1	0	0	1	Sets the LCD display normal/reverse 0: normal, 1: reverse
(10) Display all points ON/OFF	0	1	0	1	0	1	0	0	1	0	0	0	1	Display all points 0: normal display 1: all points ON
(11) LCD bias set	0	1	0	1	0	1	0	0	0	1	0	0	1	Sets the LCD drive voltage bias ratio 0: 1/9 bias, 1: 1/7 bias (ST7565P)
(12) Read/modify/write	0	1	0	1	1	1	0	0	0	0	0	0	0	Column address increment At write: +1 At read: 0
(13) End	0	1	0	1	1	1	0	1	1	1	0			Clear read/modify/write
(14) Reset	0	1	0	1	1	1	0	0	0	1	0			Internal reset
(15) Common output mode select	0	1	0	1	1	0	0	0	1	*	*	*	*	Select COM output scan direction 0: normal direction 1: reverse direction
(16) Power control set	0	1	0	0	0	1	0	1	Operating mode				Select internal power supply operating mode	
(17) V ₀ voltage regulator internal resistor ratio set	0	1	0	0	0	1	0	0	Resistor ratio				Select internal resistor ratio(Rb/Ra) mode	
(18) Electronic volume mode set	0	1	0	1	0	0	0	0	0	0	0	0	1	Set the V ₀ output voltage electronic volume register
Electronic volume register set				0	0	Electronic volume value								
(20) Booster ratio set	0	1	0	1	1	1	1	1	0	0	0	0	0	select booster ratio 00: 2x,3x,4x 01: 5x 11: 6x
(21) Power saver														Display OFF and display all points ON compound command
(22) NOP	0	1	0	1	1	1	0	0	0	1	1			Command for non-operation
(23) Test	0	1	0	1	1	1	1	*	*	*	*			Command for IC test. Do not use this command

Timing Characteristics

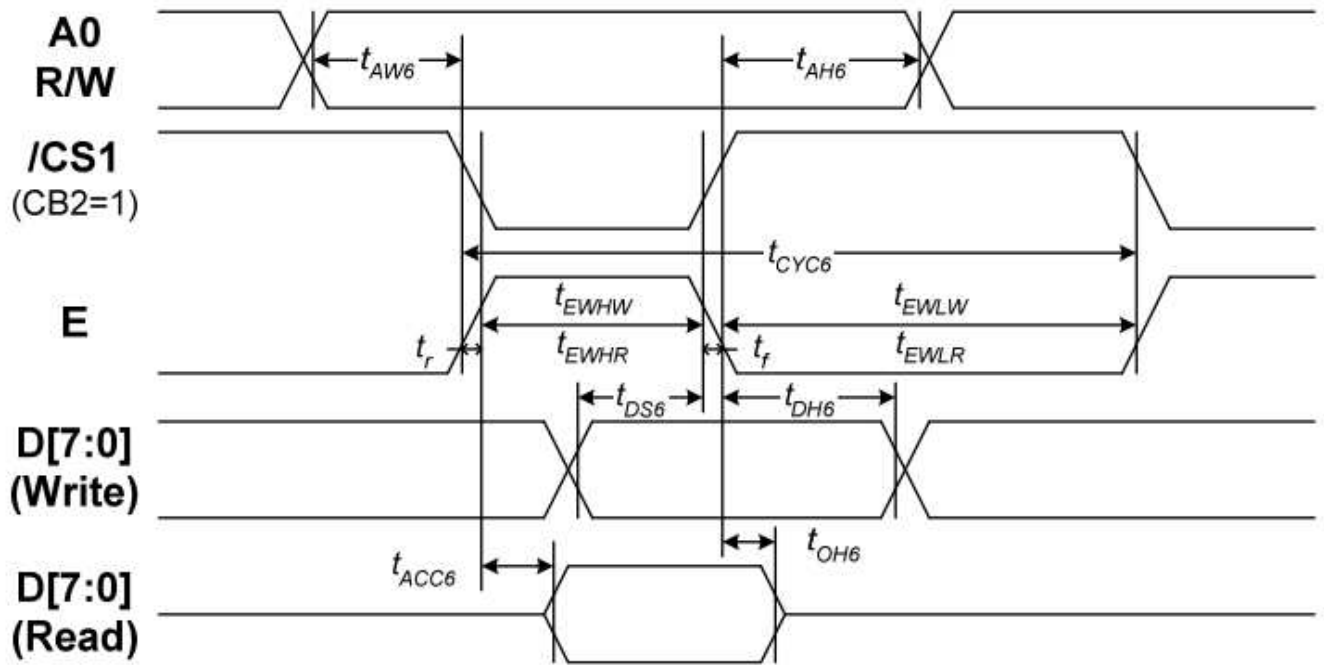
System Bus Read/Write Characteristics 1 (For the 8080 Series MPU)



(V_{DD} = 3.3V, T_a = -30 to 85°C)

Item	Signal	Symbol	Condition	Rating		Units
				Min.	Max.	
Address hold time	A0	t _{AH8}		0	—	Ns
Address setup time		t _{AW8}		0	—	
System cycle time		t _{CYC8}		240	—	
Write L pulse width	/WR	t _{CCLW}		80	—	
Write H pulse width		t _{CCHW}		80	—	
Read L pulse width	/RD	t _{CCLR}		140	—	
Read H pulse width		t _{CCHR}		80	—	
Write Data setup time	D0 to D7	t _{DS8}		40	—	
Write Address hold time		t _{DH8}		0	—	
Read access time		t _{ACC8}	CL = 100 pF	—	70	
Read Output disable time		t _{OH8}	CL = 100 pF	5	50	

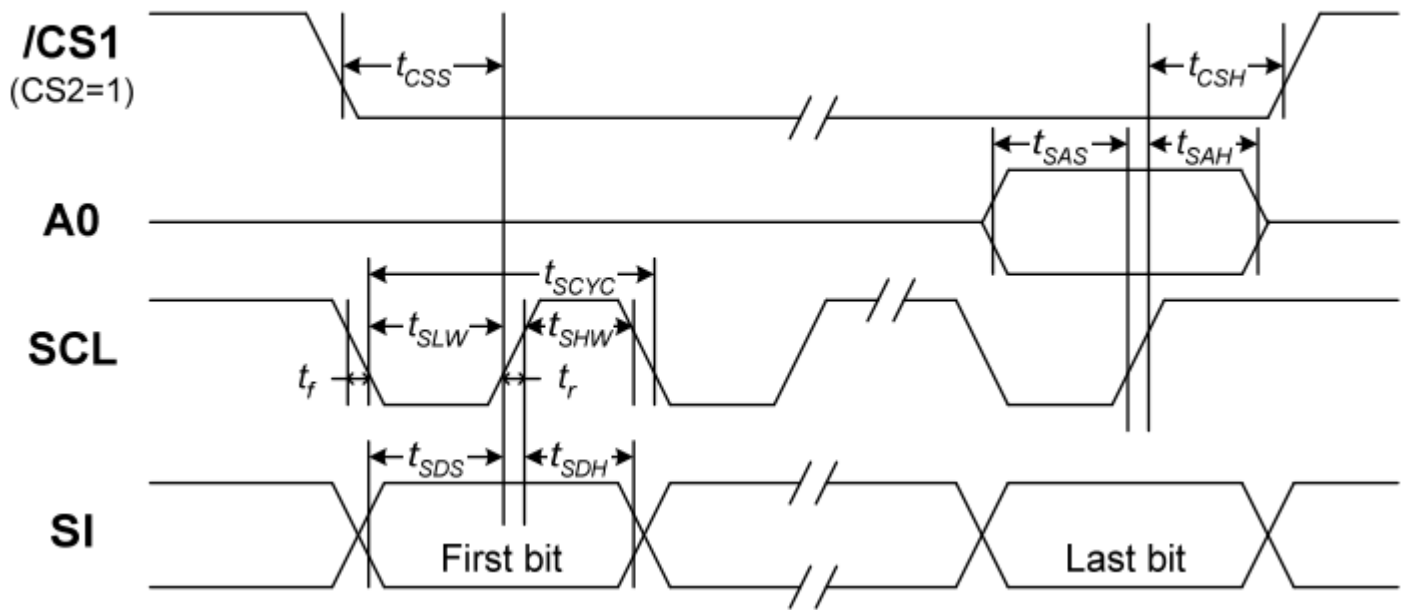
System Bus Read/Write Characteristics 2 (For the 6800 Series MPU)



($V_{DD} = 3.3V$, $T_a = -30$ to $85^\circ C$)

Item	Signal	Symbol	Condition	Rating		Units
				Min.	Max.	
Address hold time	A0	t_{AH6}		0	—	ns
Address setup time		t_{AW6}		0	—	
System cycle time		t_{CYC6}		240	—	
Enable L pulse width (WRITE)	E	t_{EHLW}		80	—	
Enable H pulse width (WRITE)		t_{EHWLW}		80	—	
Enable L pulse width (READ)		t_{EHLR}		80	—	
Enable H pulse width (READ)		t_{EHWLR}		140	—	
WRITE Data setup time	D0 to D7	t_{DS6}		40	—	
WRITE Address hold time		t_{DH6}		0	—	
READ access time		t_{ACC6}	$C_L = 100$ pF	—	70	
READ Output disable time		t_{OH6}	$C_L = 100$ pF	5	50	

The Serial Interface



($V_{DD} = 3.3V$, $T_a = -30$ to $85^\circ C$)

Item	Signal	Symbol	Condition	Rating		Units
				Min.	Max.	
Serial Clock Period	SCL	t_{SCYC}		50	—	ns
SCL "H" pulse width		t_{SHW}		25	—	
SCL "L" pulse width		t_{SLW}		25	—	
Address setup time	A0	t_{SAS}		20	—	
Address hold time		t_{SAH}		10	—	
Data setup time	SI	t_{SDS}		20	—	
Data hold time		t_{SDH}		10	—	
CS-SCL time	CS	t_{CSS}		20	—	
CS-SCL time		t_{CSH}		40	—	

Example Initialization Program

```

/*****/
void comm_out(unsigned int c)
{
    CS1 = 0; //Active Low
    AO = 0; //LOW = instruction
    delay(1);
    WRT = 0; // /WR in 8080 mode; R/W in 6800 mode
    P1 = c;
    delay(1);
    WRT = 1; // /WR in 8080 mode; R/W in 6800 mode
    CS1 = 1; //inactive
}

void data_out(unsigned int d)
{
    CS1 = 0; //Active Low
    AO = 1; //High = Data
    delay(1);
    WRT = 0;
    P1 = d;
    delay(1);
    WRT = 1;
    CS1 = 1; //inactive
}

void init()
{
    //IRS pin is tied low internally - external resistor circuit must be used
    C86 = 1;           // Interface set to 8080 mode
    RDD = 1;          // /RD in 8080 mode; E in 6800 mode
    WRT = 1;          // /WR in 8080 mode; R/W in 6800 mode
    CS1 = 0;
    RST = 1;          // /RST in 8080 mode; /RES in 6800 mode
    RST = 0;          // /RST in 8080 mode; /RES in 6800 mode
    delay(2);
    RST = 1;          // /RST in 8080 mode; /RES in 6800 mode
    delay(2);
    comm_out(0xA2);   //added 1/9 bias
    comm_out(0xA0);   //ADC segment driver direction (A0=Normal)
    comm_out(0xC8);
    comm_out(0xC0);   //COM output scan direction (C0= Normal)
    comm_out(0x40);   //Operating Mode
    comm_out(0x25);   //resistor ratio
    comm_out(0x19);   //column address set upper bit
    comm_out(0x2F);   //select internal resistor ratio
    comm_out(0xAF);   //display ON/OFF - set to ON
}
/*****/

```

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

Warranty Information and Terms & Conditions

http://www.newhavendisplay.com/index.php?main_page=terms