

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 Positive
H-	Transflective, Wide Temperature, 6:00 Optimal View
#-M-	Mounting Holes
	RoHS Compliant

Newhaven Display International, Inc.

2661 Galvin Court

Elgin IL, 60124

Ph: 847-844-8795

Fax: 847-844-8796

www.newhavendisplay.com

nhtech@newhavendisplay.com

nhsales@newhavendisplay.com

Document Revision History

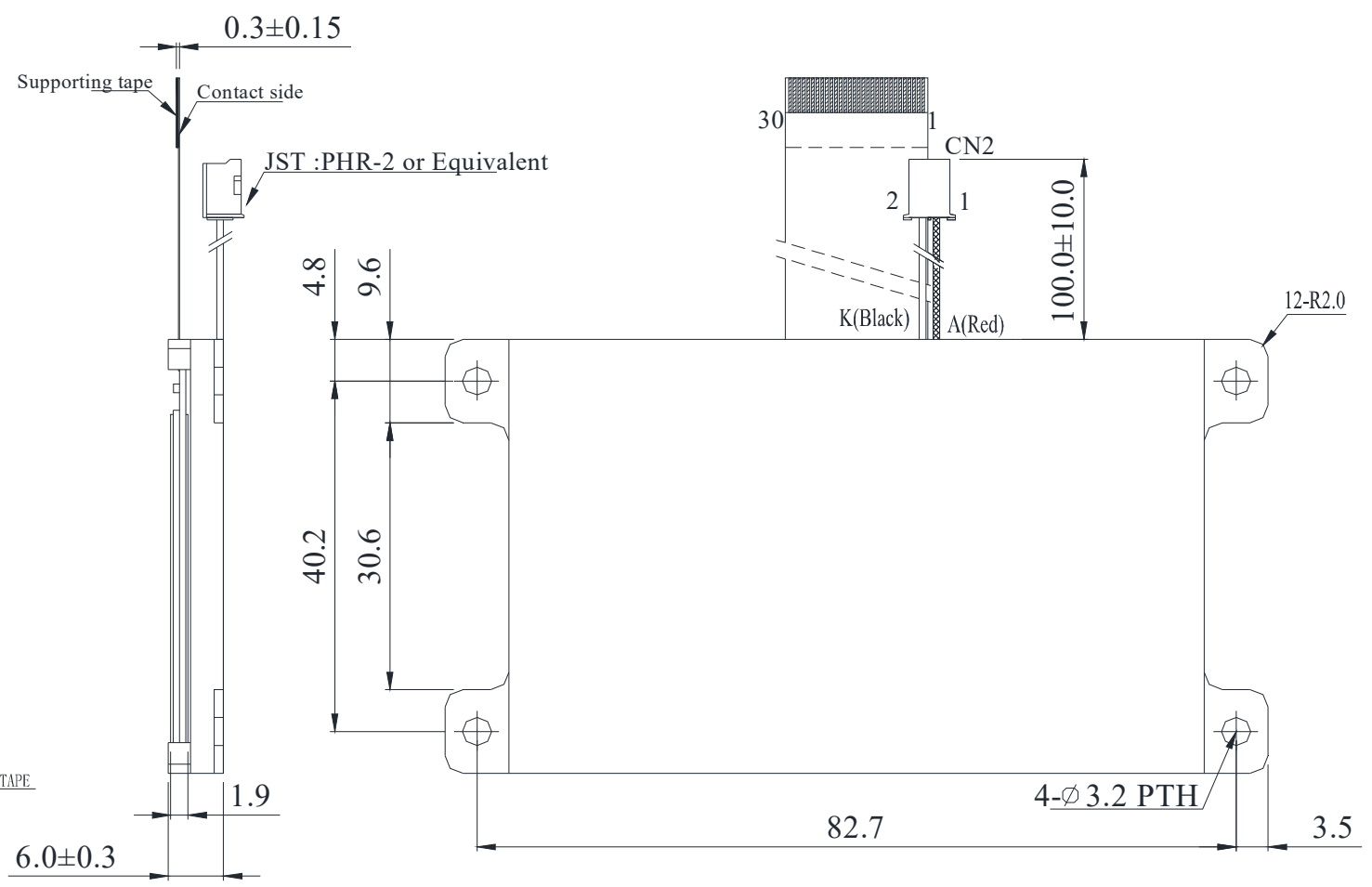
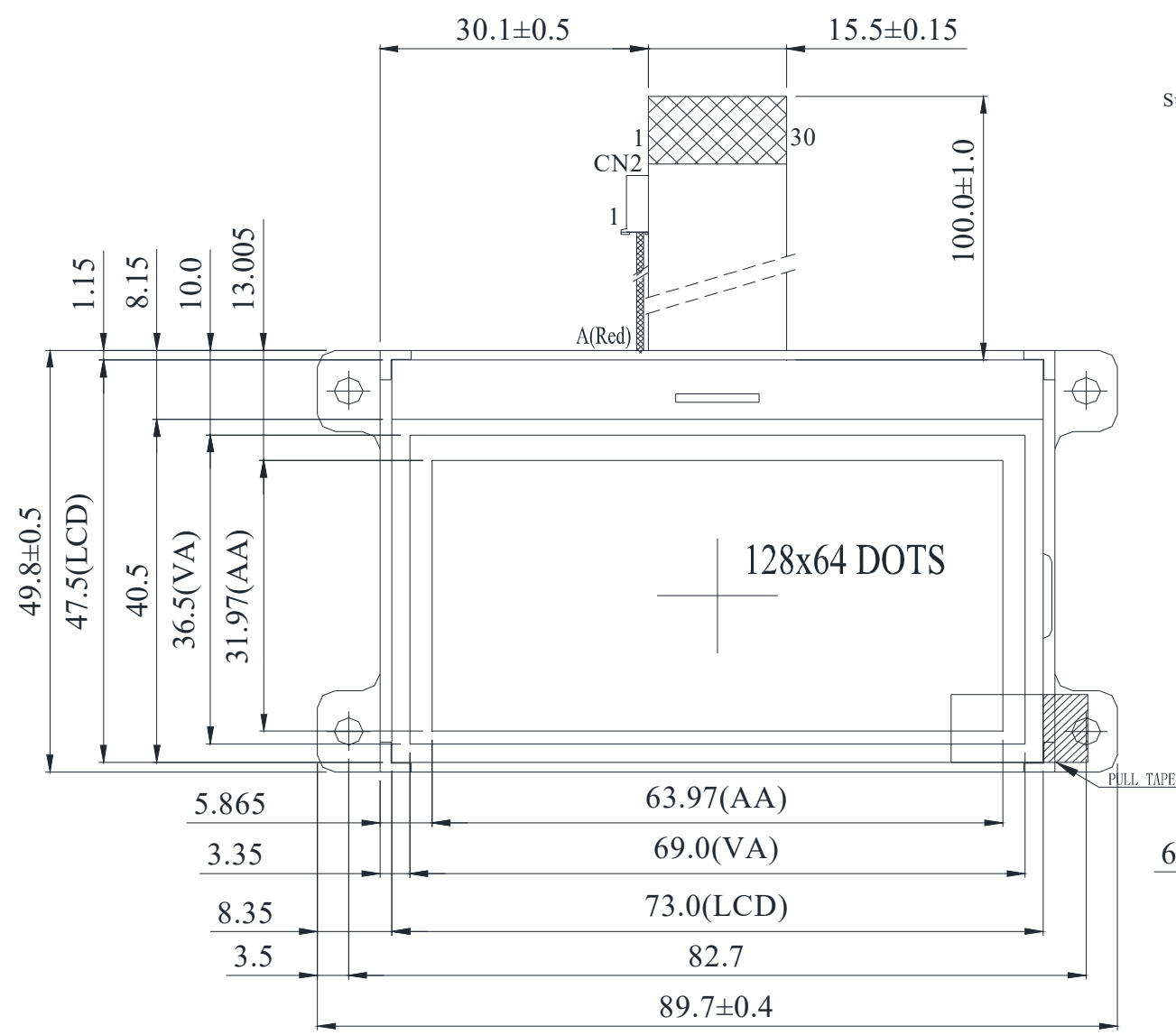
Revision	Date	Description	Changed by
0	9/1/08	Initial Release	-
1	11/12/09	User guide reformat	MC
2	12/14/09	Block Diagram Update	MC
3	2/12/10	Added –M to p/n to signify this part has mounting holes	MC
4	3/9/10	Block diagram updated	BE
5	5/4/10	Block diagram and pin description	MP
6	5/5/10	Backlight Connectors updated	BE
7	5/14/10	Pin description update	MP
8	5/2/11	Example initialization code updated	AK
9	5/13/11	Block diagram updated	AK
10	5/19/11	Block diagram & Pin description updated	AK
11	1/10/12	Pin description & Controller link updated	AK
12	6/15/12	Timing characteristics updated	AK
13	4/4/13	Backlight mating connector, LCD voltage levels updated	AK
14	4/15/13	Optical characteristics updated	AK
15	3/16/15	Pin description Updated	RM
16	12/30/16	Electrical Characteristics & Response Time Updated	SB
17	2/6/17	I _{LED} Updated	SB
18	4/16/20	Initialization Code Updated	TM
19	3/3/21	Updated Tolerance on 2D Mechanical Drawing, MIN Supply Current, Backlight Drive Conditions & Quality Information	AS

Functions and Features

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

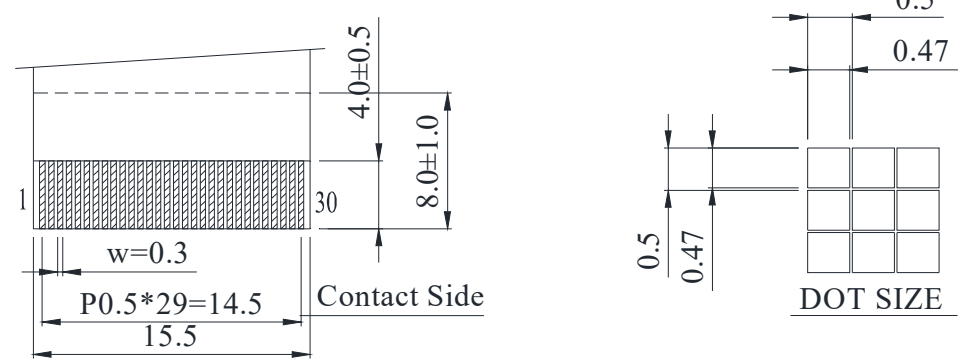
Mechanical Drawing

SYMBOL	REVISION	DATE



PIN NO.	SYMBOL	PIN NO.	SYMBOL	PIN NO.	SYMBOL
1	CS1B	11	D5	21	CAP2N
2	/RES	12	D6	22	V4
3	A0	13	D7	23	V3
4	/WR(R/W)	14	VDD	24	V2
5	/RD(E)	15	V _{SS}	25	V1
6	D0	16	VOUT	26	V0
7	D1	17	CAP3P	27	VR
8	D2	18	CAP1N	28	C86
9	D3	19	CAP1P	29	P/S
10	D4	20	CAP2P	30	NC

- Notes:**
1. Driver: 1/65 Duty, 1/9 Bias
 2. Resolution: 128x64 Pixels
 3. Voltage: 3.0V VDD, 9.45V VLCD
 4. Display Mode: FSTN Positive / Transflective
 5. Optimal View: 6:00
 6. Backlight: White LED
 7. Driver IC: ST7565P



Standard Tolerance:
(Unless otherwise specified)
Linear: ±0.3mm

NEWHAVEN DISPLAY INTERNATIONAL

Drawing/Part Number: **NHD-C12864WO-B1TFH#-M** Revision: 1.0
 Size: A3
 Scale: NS

Unless otherwise specified:
 • Dimensions are in Millimeters
 • Third Angle Projection

Drawn By: A. Shah Approved By: A. Shah
 Drawn Date: 3/3/2021 Approved Date: 3/3/2021

Do Not Scale Drawing Sheet 1 of 1

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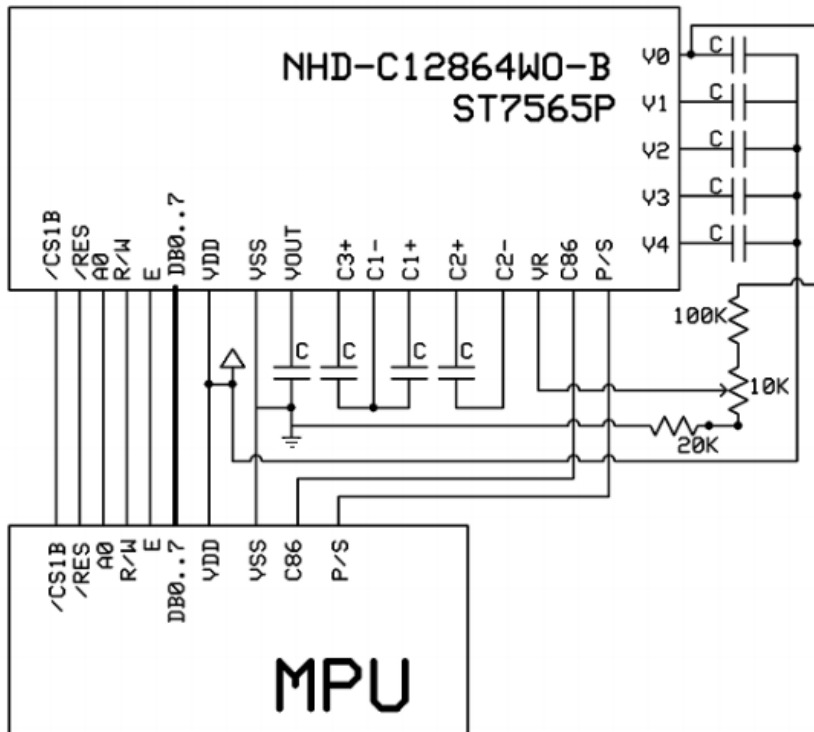
Pin Description and Wiring Diagram

Pin No.	Symbol	External Connection	Function Description
1	/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	6800 Mode: Read/Write select signal. R/W=1: Read R/W=0: Write 8080 Mode: Active LOW Write Signal
5	E /RD	MPU	6800 Mode: Active HIGH Enable Signal 8080 Mode: Active LOW Read Signal
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	V _{DD}	Power Supply	Power supply for logic (+3V)
15	V _{SS}	Power Supply	Ground
16	V _{OUT}	Power Supply	1-4.7 μF cap to V _{SS}
17	CAP3P	Power Supply	1-4.7 μF cap to CAP1N (pin-18)
18	CAP1N	Power Supply	1-4.7 μF cap to CAP3P (pin-17) and CAP1P (pin-19)
19	CAP1P	Power Supply	1-4.7 μF cap to CAP1N (pin-18)
20	CAP2P	Power Supply	1-4.7 μF cap to CAP2N (pin-21)
21	CAP2N	Power Supply	1-4.7 μF cap to CAP2P (pin-20)
22-26	V ₄ ~V ₀	Power Supply	0.1-4.7 μF cap to VDD or VSS
27	V _R	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	T _{OP}	Absolute Max	-20	-	+70	°C
Storage Temperature Range	T _{ST}	Absolute Max	-30	-	+80	°C
Supply Voltage	V _{DD}	-	2.7	3.0	3.3	V
Supply Current	I _{DD}	V _{DD} = 3.0V T _{OP} = 25°C	0.1	0.6	2.0	mA
Supply for LCD (contrast)	V _{LCD}		9.2	9.5	9.8	V
"H" Level input	V _{IH}	-	0.8 * V _{DD}	-	V _{DD}	V
"L" Level input	V _{IL}	-	V _{SS}	-	0.2 * V _{DD}	V
"H" Level output	V _{OH}	-	0.8 * V _{DD}	-	V _{DD}	V
"L" Level output	V _{OL}	-	V _{SS}	-	0.2 * V _{DD}	V
LED Backlight voltage	V _{LED}	I _{LED} = 65mA	3.4	3.5	3.6	V
LED Backlight current	I _{LED}	-	30	65	80	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	CR ≥ 2	-	30	-	°
	Bottom		-	60	-	°
	Left		-	45	-	°
	Right		-	45	-	°
Contrast Ratio	CR	-	2	5	-	-
Response Time	Rise	T _{OP} = 25°C	-	200	300	ms
	Fall		-	250	350	ms

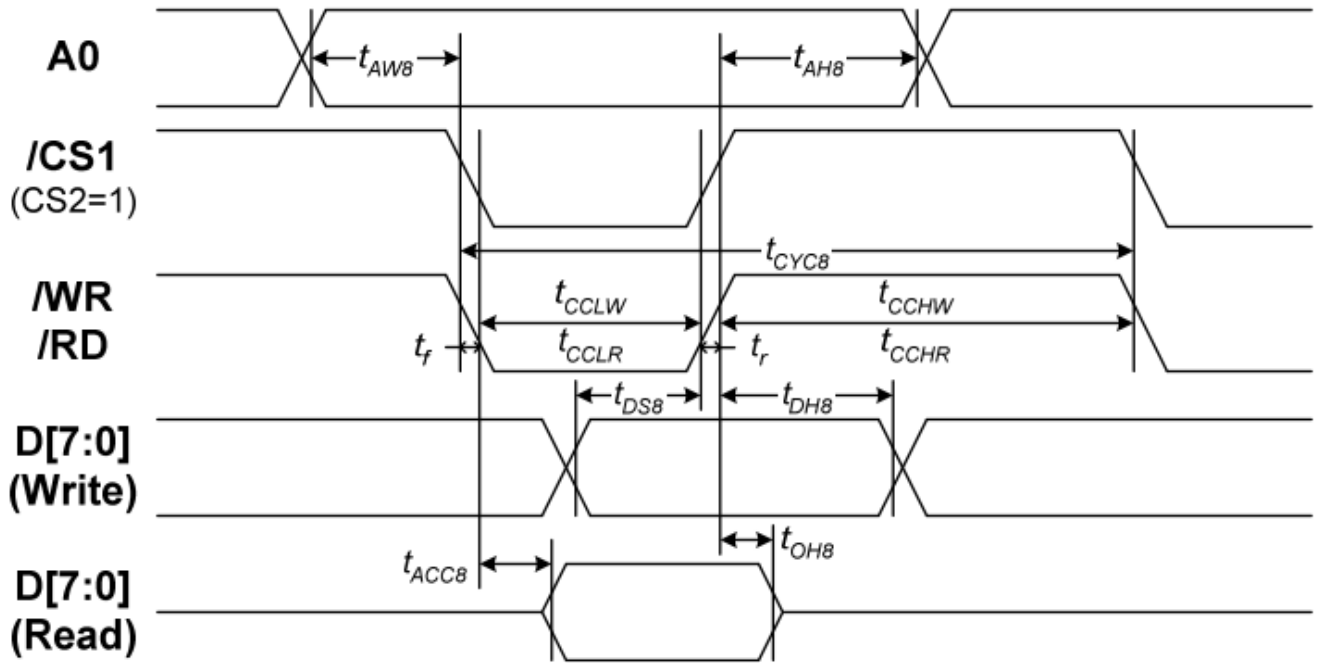
Controller Information

Built-in ST7565P controller

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

Timing Characteristics

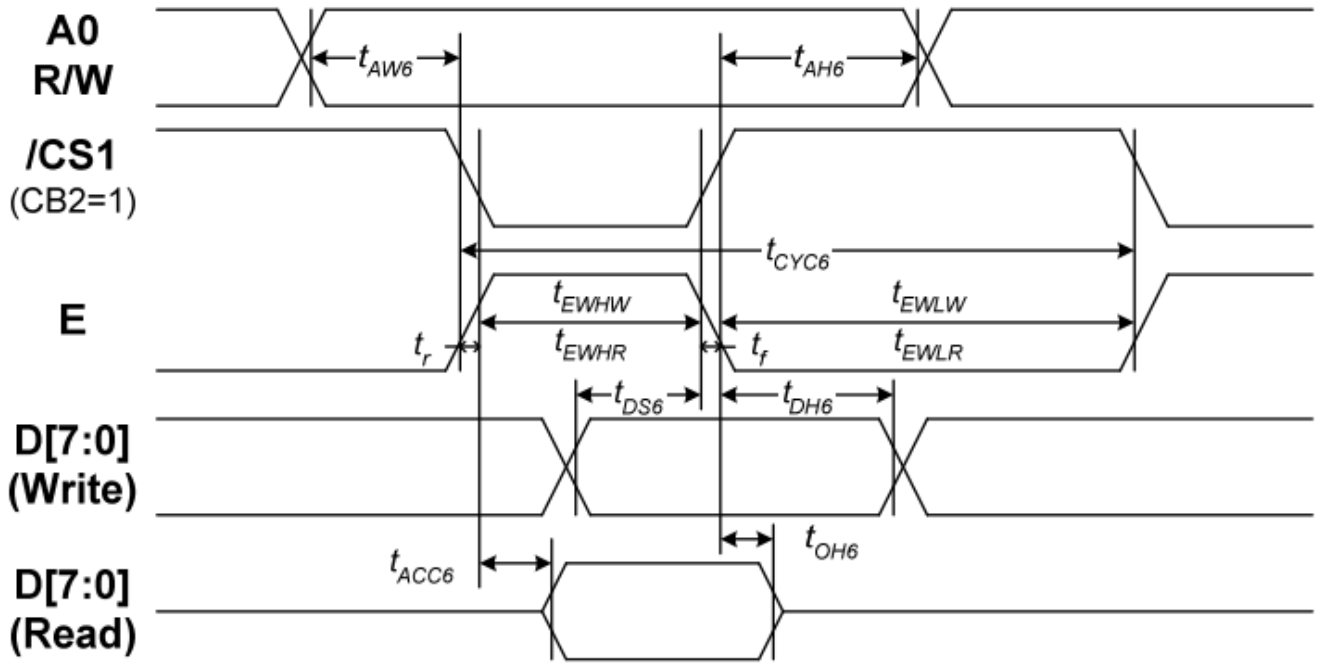
System Bus Read/Write Characteristics 1 (For the 8080 Series MPU)



(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	

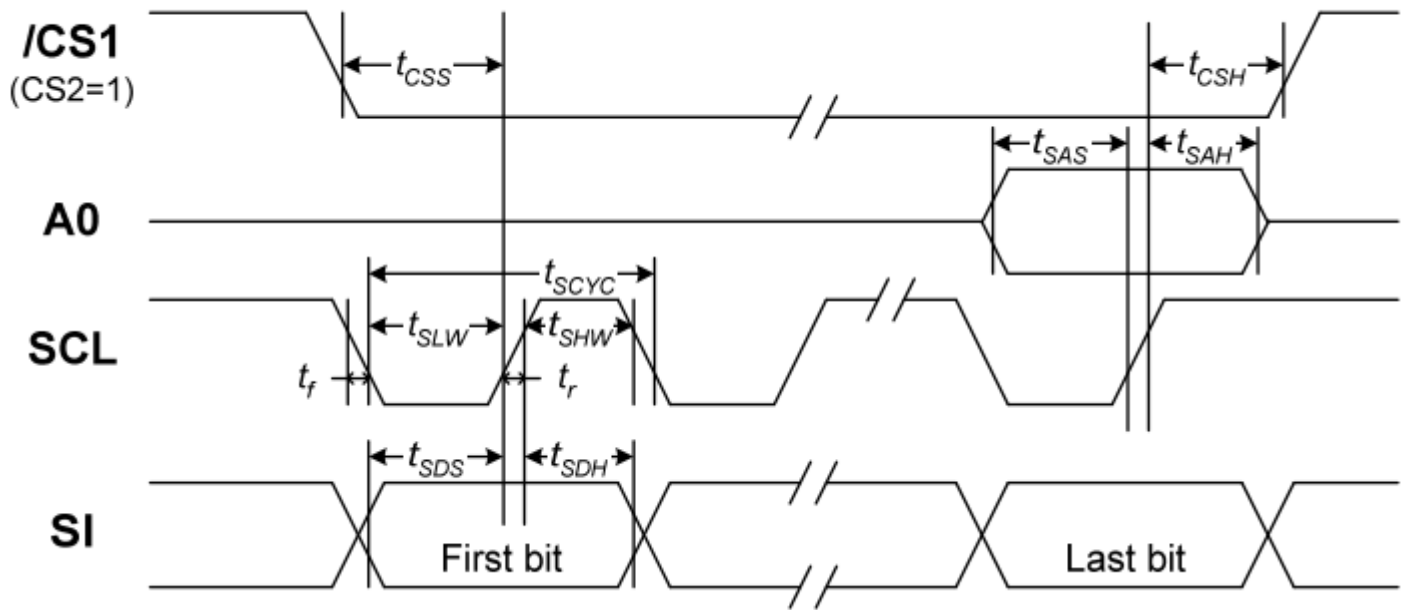
System Bus Read/Write Characteristics 2 (For the 6800 Series MPU)



($V_{DD} = 3.3V$, $T_a = -30$ 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_{EWLW}		80	—	
Enable H pulse width (WRITE)		t_{EWHW}		80	—	
Enable L pulse width (READ)		t_{EWLR}		80	—	
Enable H pulse width (READ)		t_{EWHR}		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	—	

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						0	Sets the display RAM display start line address
(3) Page address set	0	1	0	1	0	1	1	Page address				0	Sets the display RAM page address
(4) Column address set upper bit	0	1	0	0	0	0	1	Most significant column address				0	Sets the most 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				0	Sets the least significant 4 bits of the display RAM column address.
(5) Status read	0	0	1	Status				0	0	0	0	0	Reads the status data
(6) Display data write	1	1	0	Write data							0	Writes to the display RAM	
(7) Display data read	1	0	1	Read data							0	Reads from the display RAM	
(8) ADC select	0	1	0	1	0	1	0	0	0	0	0	0	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	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	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	1	Sets the LCD drive voltage bias ratio 0: 1/9 bias, 1: 1/7 bias (ST7565)
(12) Read/modify/write	0	1	0	1	1	1	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	0	Clear read/modify/write
(14) Reset	0	1	0	1	1	1	0	0	0	1	0	0	Internal reset
(15) Common output mode select	0	1	0	1	1	0	0	0	0	*	*	*	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			0	Select internal power supply operating mode
(17) Vs voltage regulator internal resistor ratio set	0	1	0	0	0	1	0	0	Resistor ratio			0	Select internal resistor ratio(Rb/Ra) mode
(18) Electronic volume mode set	0	1	0	1	0	0	0	0	0	0	0	1	Set the Vs output voltage electronic volume register
Electronic volume register set	0	1	0	0	0	Electronic volume value						0	
(19) Static indicator ON/OFF	0	1	0	1	0	1	0	1	1	0	0	0	0: OFF, 1: ON
Static indicator register set	0	1	0	0	0	0	0	0	0	0	Mode	1	Set the flashing mode
(20) Power saver													Display OFF and display all points ON compound command
(21) NOP	0	1	0	1	1	1	0	0	0	1	1	1	Command for non-operation
(22) Test	0	1	0	1	1	1	1	*	*	*	*	*	Command for IC test. Do not use this command

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()  
{  
    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);   // LCD drive voltage bias ratio. 1/9 bias  
    comm_out(0xA0);   // ADC segment driver direction (A0=Normal)  
    comm_out(0xC0);   // COM output scan direction (C0= Normal)  
    comm_out(0x40);   // Display Start Line address  
    comm_out(0x25);   // Resistor ratio set  
    comm_out(0x10);   // Column address upper 4 bits + 0x10  
    comm_out(0x00);   // Column address lower 4 bits + 0x00  
    comm_out(0x81);   // Electronic Volume Command (set contrast) Double Byte: 1 of 2  
    comm_out(0x25);   // Electronic Volume value (contrast value) Double Byte: 2 of 2 //was 0x19  
    comm_out(0x2F);   // Power Control Set  
    comm_out(0xAF);   // Display 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 Storage	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.	Air: ±800V 150pF/330Ω, 10 Times Contact: ±600V 150pF/330Ω, 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 and Terms & Conditions

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