NHD-C12864WO-B1TMI#-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
M-	STN Negative, Blue
I-	Transmissive, 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

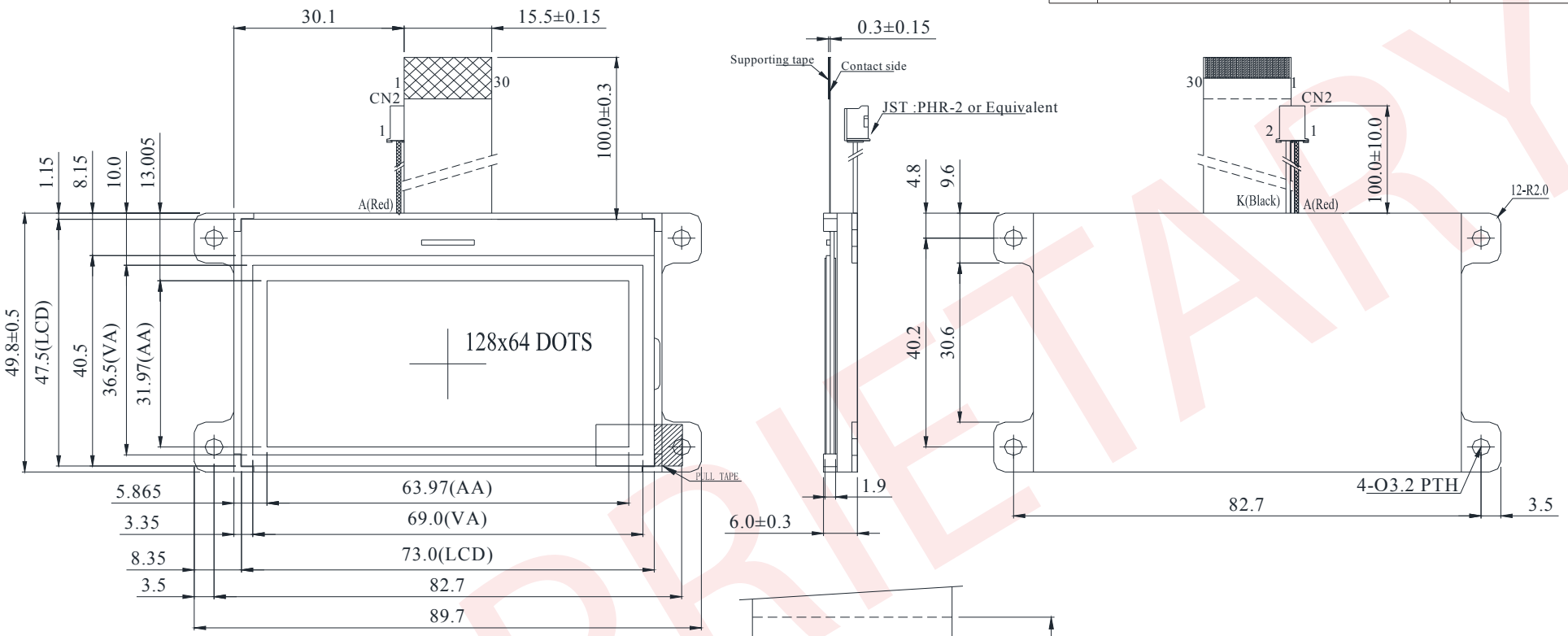
Revision	Date	Description	Changed by
0	9/1/2008	Initial Release	-
1	11/12/2009	User guide reformat	MC
2	12/14/2009	Updated Block Diagram	MC
3	1/12/2010	Added –M to p/n to signify this part has mounting holes	MC
4	3/9/2010	Block diagram updated	BE
5	5/4/2010	Block diagram and pin description	MP
6	5/5/2010	Backlight Connector 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
14	4/17/2013	Optical characteristics updated	AK
15	3/16/2015	Pin Description updated	RM
16	12/30/16	Electrical Characteristics & Response Time Updated	SB
17	2/6/17	I_{LED} Updated	SB
18	7/27/17	Backlight Characteristics Updated	SB
19	12/26/18	Backlight Voltage Updated	SB
20	4/22/20	Initialization Code Updated	TM

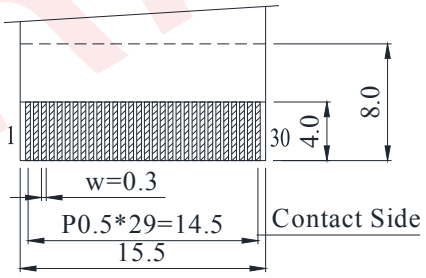
Functions and Features

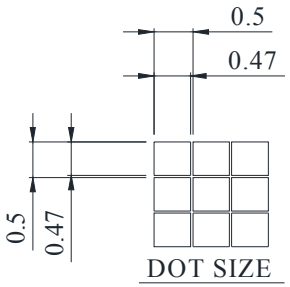
- 128 x 64 pixels
- Built-in ST7565P controller
- +3.3V power supply
- 1/65 duty cycle; 1/9 bias
- RoHS Compliant

Mechanical Drawing

Rev	Description	Date







Notes:

1. Driver:	1/65 Duty, 1/9 Bias
2. Resolution:	128x64 Pixels
3. Voltage:	3.0V VDD, 9.5V VLCD
4. Display Mode:	STN Negative / Blue / Transmissive
5. Optimal View:	6:00
6. Backlight:	White LED
7. Driver IC:	ST7565P

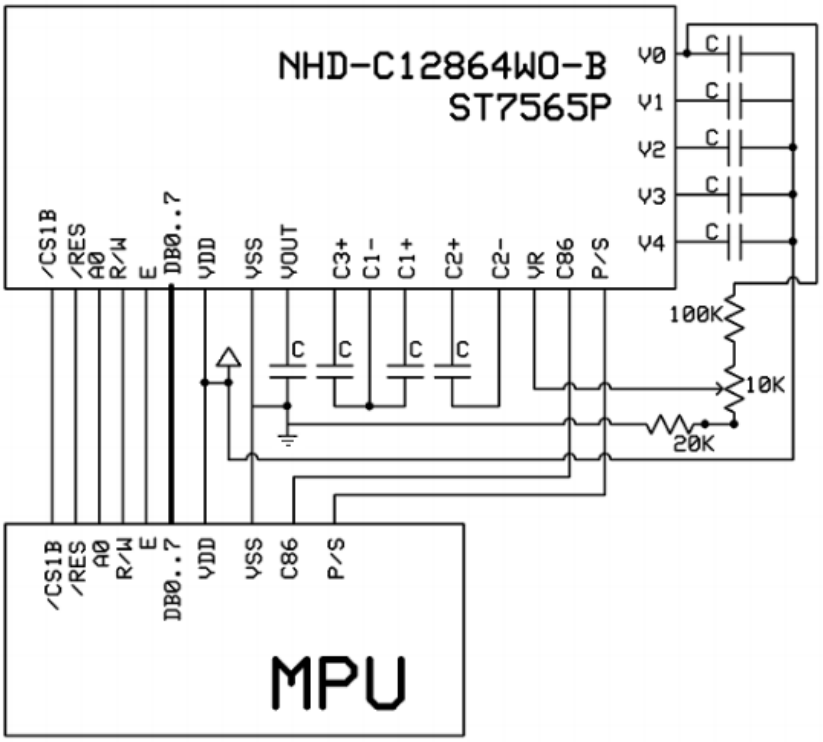
PIN NO.	SYMBOL	PIN NO.	SYMBOL	PIN NO.	SYMBOL
1	CS1B	11	D5	21	CAP2N
2	/RES	12	D6	22	V4
3	A0	13	D7	23	V3
4	/WR(R/W)	14	VDD	24	V2
5	/RD(E)	15	Vss	25	V1
6	D0	16	VOUT	26	V0
7	D1	17	CAP3P	27	VR
8	D2	18	CAP1N	28	C86
9	D3	19	CAP1P	29	P/S
10	D4	20	CAP2P	30	NC

Unit		
mm	NEWHAVEN DISPLAY INTERNATIONAL	
Gen. Tol.	Date	Part Number:
±0.3	12/30/16	NHD-C12864WO-B1TMI#-M

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	1.0 - 4.7 µF cap to V_{SS}
17	CAP3P	Power Supply	1.0 - 4.7 µF cap to CAP1N (pin-18)
18	CAP1N	Power Supply	1.0 - 4.7 µF cap to CAP3P (pin-17) and CAP1P (pin-19)
19	CAP1P	Power Supply	1.0 - 4.7 µF cap to CAP1N (pin-18)
20	CAP2P	Power Supply	1.0 - 4.7 µF cap to CAP2N (pin-21)
21	CAP2N	Power Supply	1.0 - 4.7 µF cap to CAP2P (pin-20)
22-26	V_4~V_0	Power Supply	0.1 4.7 µF cap to V_{DD} or V_{SS}
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/Serial 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	0.2	0.6	2.0	mA
Supply for LCD (contrast)	V_{LCD}	T_{OP} = 25°C	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
Backlight Supply Current	I_{LED}	-	-	65	80	mA
Backlight Supply Voltage	V_{LED}	I_{LED} = 65mA	3.4	3.5	3.6	V

*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	-	20	-	°
	Bottom	φY-		-	40	-	°
	Left	θX-		-	30	-	°
	Right	θX+		-	30	-	°
Contrast Ratio		CR	-	2	3	-	-
Response Time	Rise	T_R	T_{OP} = 25°C	-	200	300	ms
	Fall	T_F		-	250	350	ms

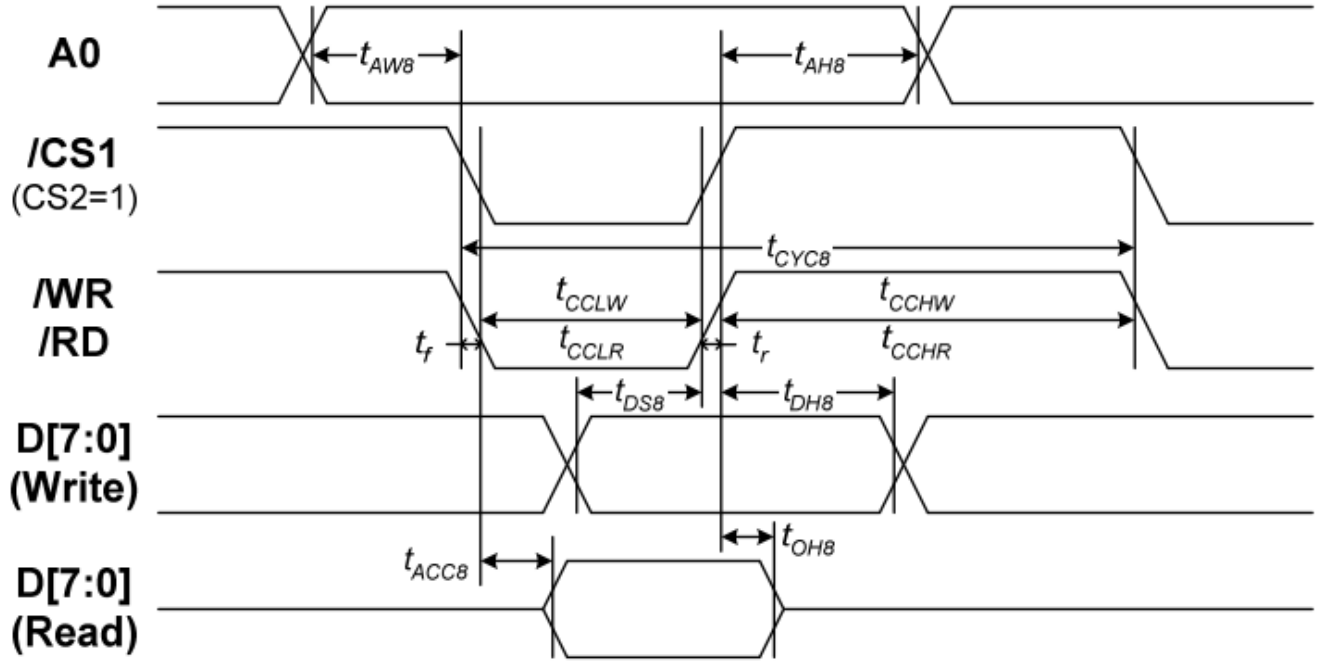
Controller Information

Built-in ST7565P controller

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

Timing Characteristics

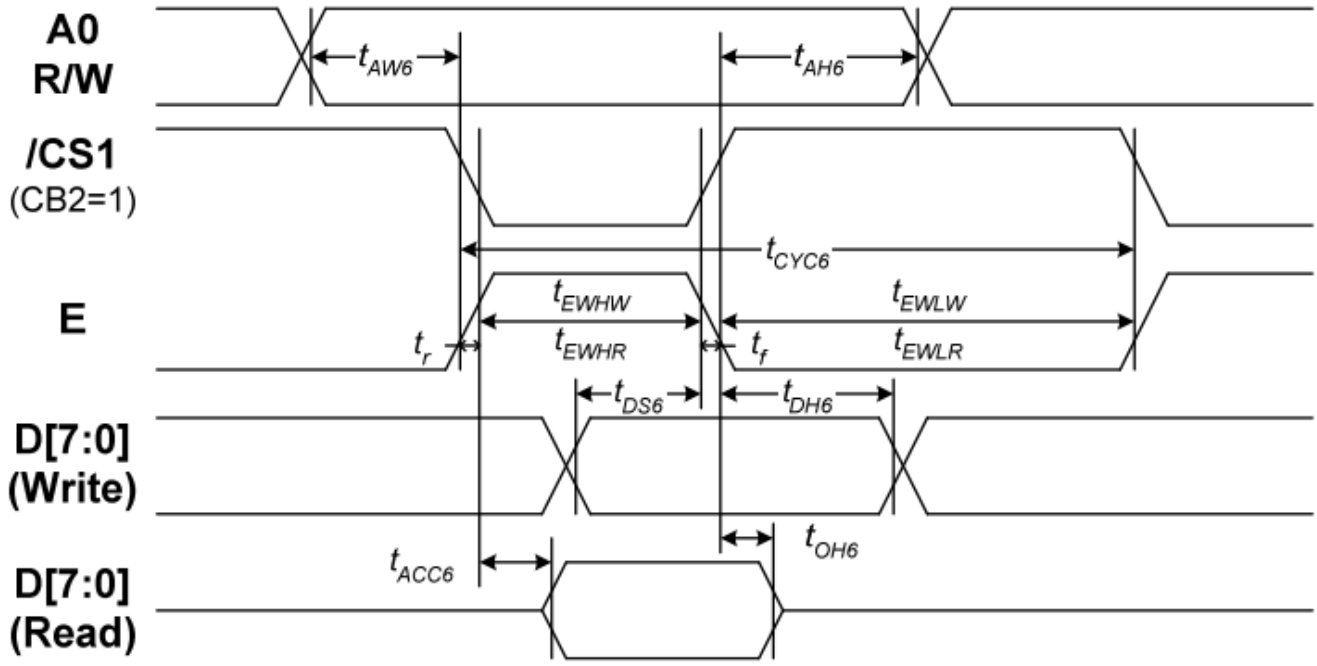
System Bus Read/Write Characteristics 1 (For the 8080 Series MPU)



(V_{DD} = 3.3V, Ta = –30 to 85℃)

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}	C_L = 100 pF	—	70	
Read Output disable time		t_{OH8}	C_L = 100 pF	5	50	

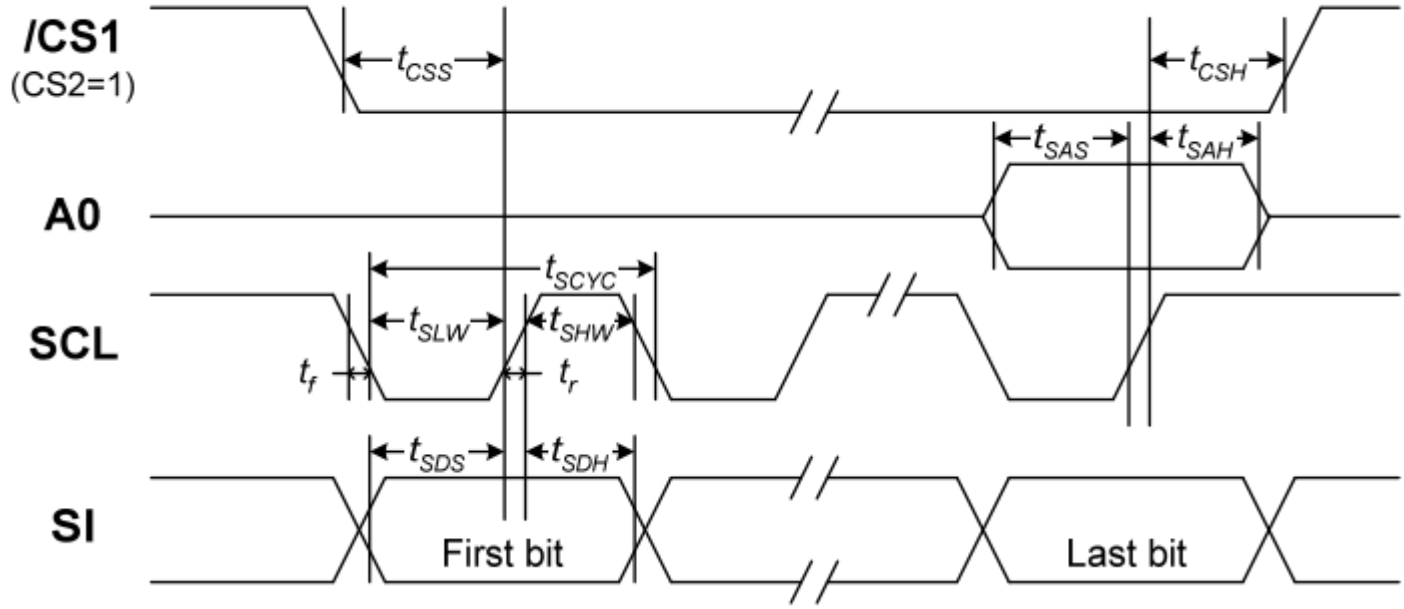
System Bus Read/Write Characteristics 2 (For the 6800 Series MPU)



(V_{DD} = 3.3V, Ta = –30 to 85℃)

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



(VDD = 3.3V, Ta = –30 to 85℃)

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						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.
Column address set lower bit	0	1	0	0	0	0	0	Least significant column address				Sets the least significant 4 bits of the display RAM 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 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 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	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_5 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	1	Set the V_5 output voltage electronic volume register
Electronic volume register set				0	0	Electronic volume value						
(19) Static indicator ON/OFF	0	1	0	1	0	1	0	1	1	0	0 1	0: OFF, 1: ON
Static indicator register set				0	0	0	0	0	0	Mode		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	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 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.	V_S=800V, R_S=330Ω, C_S=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 and Terms & Conditions

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