

# NHD-C12864M1R-FSW-FTW-3V6

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

NHD-	Newhaven Display
C12864-	128 x 64 pixels
M1R-	Model
F-	Transflective
SW-	Side White LED Backlight
F-	FSTN (+)
T-	12:00 Optimal View
W-	Wide Temperature
3V6-	3.3V LCD, 6.0V Backlight
	<b>RoHS Compliant</b>

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## Document Revision History

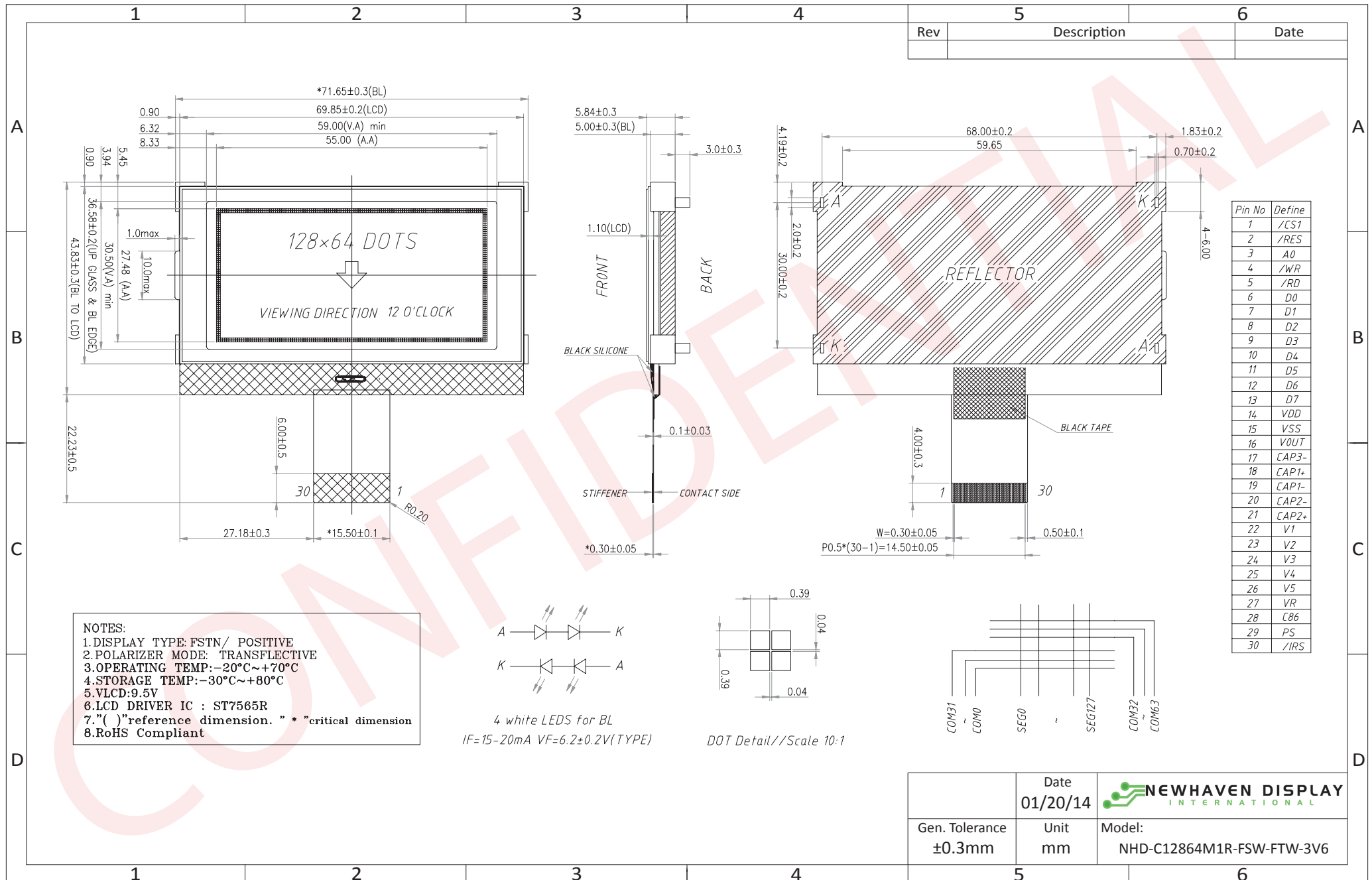
Revision	Date	Description	Changed by
0	5/6/2009	Initial Release	-
1	10/13/2009	User guide reformat	MC
2	11/20/2009	Updated backlight supply current	MC
3	6/22/2010	Updated drawing to include bkl adhesive	CL
4	2/3/2011	Updated drawing with pin numbers	AK
5	2/13/2011	Change controller to ST7565R	CL
6	3/28/2011	Controller information updated	AK
7	1/20/2014	Mechanical drawing, Electrical characteristics updated	AK

## Functions and Features

- 128 x 64 pixels
- 8080 or 6800 MPU interface
- Built-in ST7565R controller
- +3.3V power supply
- 1/64 duty cycle; 1/9 bias
- RoHS Compliant
- 3M 9080 adhesive on backlight assembly

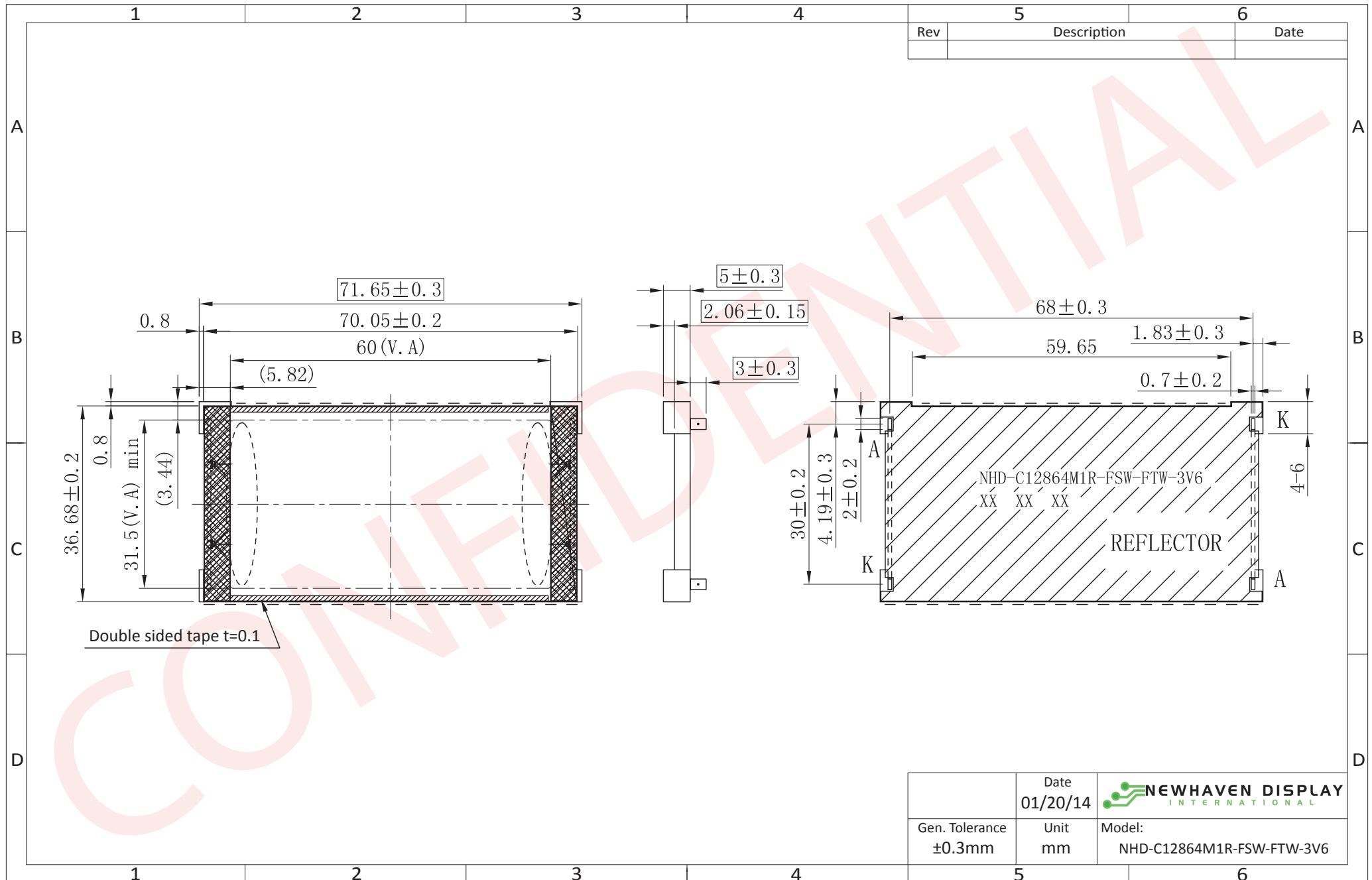
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# Mechanical Drawing



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# Mechanical Drawing - Backlight



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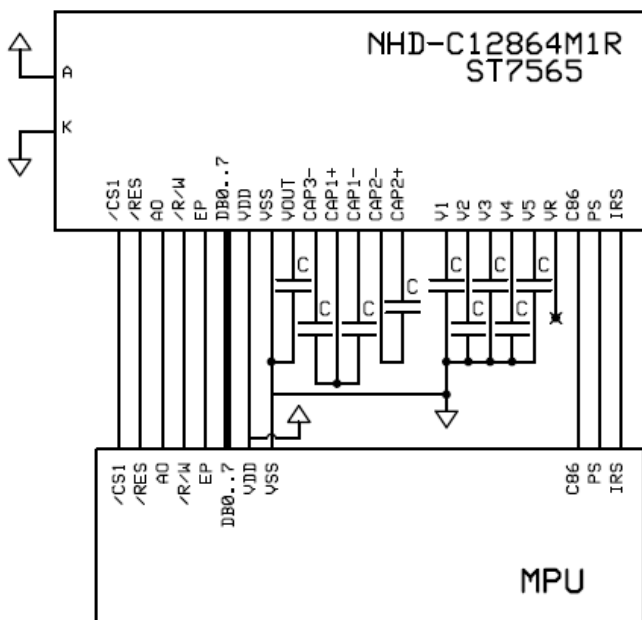
## Pin Description and Wiring Diagram

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 register
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	DB0	MPU	Parallel Interface DB0-DB7: Bi-directional 8-bit data bus
7	DB1	MPU	
8	DB2	MPU	
9	DB3	MPU	
10	DB4	MPU	
11	DB5	MPU	
12	DB6 (SCL)	MPU	
13	DB7 (SI)	MPU	
14	VDD	Power Supply	Power supply for LCD and logic (+3.3V)
15	VSS	Power Supply	Ground
16	VOUT	Power Supply	Connect to 1uF cap to VSS
17	CAP3-	Power Supply	Connect to 1uF cap to CAP1+ (PIN-18)
18	CAP1+	Power Supply	Connect to 1uF cap to CAP3-(PIN17) and CAP1-(PIN19)
19	CAP1-	Power Supply	Connect to 1uF cap to CAP1+ (PIN-18)
20	CAP2-	Power Supply	Connect to 1uF cap to CAP2+ (PIN-21)
21	CAP2+	Power Supply	Connect to 1uF cap to CAP2- (PIN-20)
22	V1	Power Supply	1.0uF-2.2uF cap to VSS
23	V2	Power Supply	1.0uF-2.2uF cap to VSS
24	V3	Power Supply	1.0uF-2.2uF cap to VSS
25	V4	Power Supply	1.0uF-2.2uF cap to VSS
26	V5	Power Supply	1.0uF-2.2uF cap to VSS
27	VR	-	No Connect
28	C86	MPU	Select MPU interface pin. C86=H: 6800; C86=L: 8080
29	PS	MPU	Parallel/Serial select. PS= H: Parallel; PS=L: Serial
30	/IRS	MPU	Internal resistor select. Set HIGH to use internal resistors

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

**Backlight connector:** --

**Mates with:** --



## 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	3.6	V
Supply Current	IDD	Ta=25°C, VDD=3.3V	-	0.25	0.50	mA
Supply for LCD (contrast)	VDD-V0	Ta=25°C	9.2	9.5	9.8	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
Backlight Supply Voltage	VLED		5.7	6.1	6.5	V
Backlight Supply Current	ILED	VLED=6.1V	-	40	50	mA

## Optical Characteristics

Item	Symbol	Condition	Min.	Typ.	Max.	Unit
Viewing Angle – Top		CR ≥ 2	-	40	-	°
Viewing Angle – Bottom			-	20	-	°
Viewing Angle – Left			-	40	-	°
Viewing Angle – Right			-	40	-	°
Contrast Ratio	CR		-	4	-	-
Response Time (rise)	Tr		-	150	250	ms
Response Time (fall)	Tf		-	150	250	ms

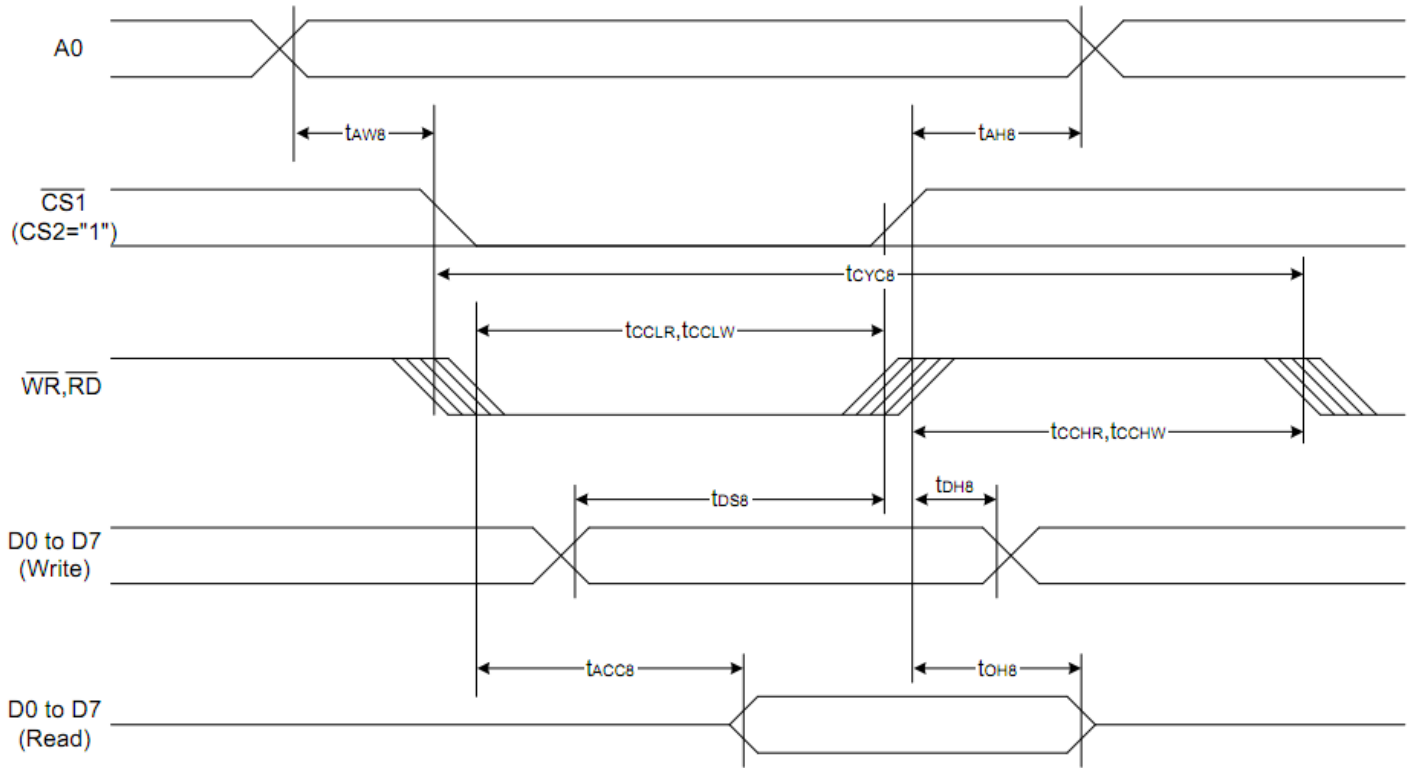
## Controller Information

Built-in ST7565R controller.

Please download specification at [http://www.newhavendisplay.com/app\\_notes/ST7565R.pdf](http://www.newhavendisplay.com/app_notes/ST7565R.pdf)

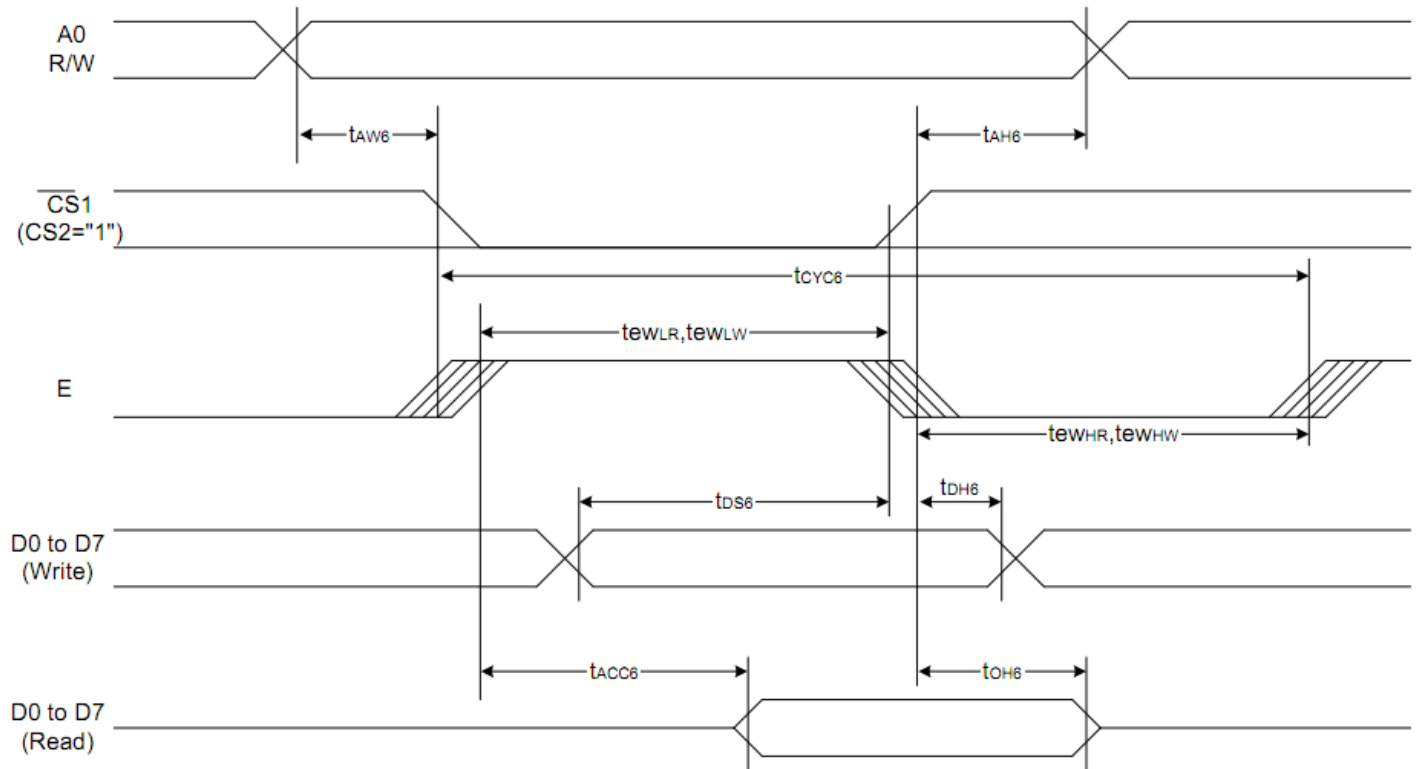
# Timing Characteristics

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



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	—	
Enable L pulse width (WRITE)	WR	$t_{CCLW}$		80	—	
Enable H pulse width (WRITE)		$t_{CCHR}$		80	—	
Enable L pulse width (READ)	RD	$t_{CCLR}$		140	—	
Enable H pulse width (READ)		$t_{CCHR}$		80	—	
WRITE Data setup time	D0 to D7	$t_{DSE}$		40	—	
WRITE Address hold time		$t_{DH8}$		0	—	
READ access time		$t_{ACC8}$	$C_L = 100 \text{ pF}$	—	70	
READ Output disable time		$t_{OH8}$	$C_L = 100 \text{ pF}$	5	50	

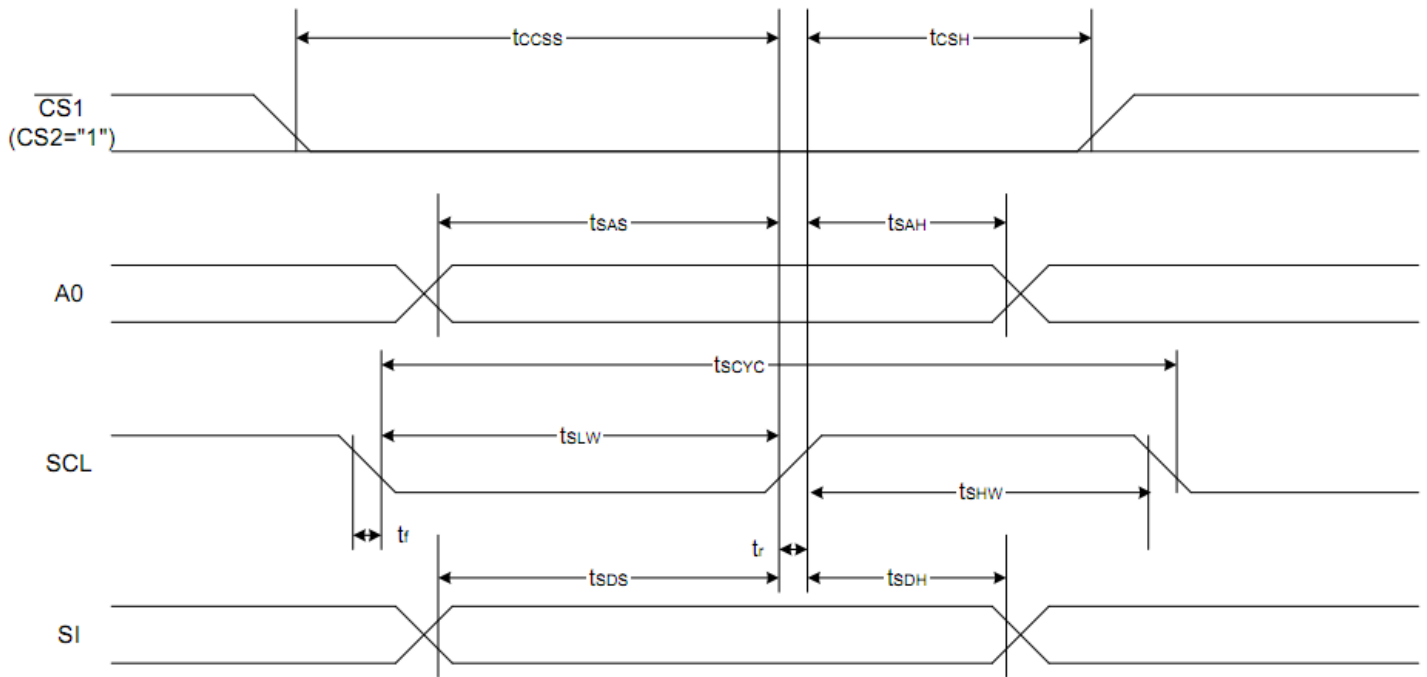
## System Bus Read/Write Characteristics 2 (For the 6800 Series MPU)



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)	WR	$t_{ewLW}$		80	—	
Enable H pulse width (WRITE)		$t_{ewHW}$		80	—	
Enable L pulse width (READ)	RD	$t_{ewLR}$		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		$t_{ACC6}$	$C_L = 100 \text{ pF}$	—	70	
READ Output disable time		$t_{OH6}$	$C_L = 100 \text{ pF}$	5	50	



## The 4-line SPI Interface



Item	Signal	Symbol	Condition	Rating		Units
				Min.	Max.	
4-line SPI 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	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	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	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 (ST7565R)
(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	0	1	0	Internal reset
(15) Common output mode select	0	1	0	1	1	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) V <sub>0</sub> 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 V <sub>0</sub> output voltage electronic volume register
Electronic volume register set				0	0	Electronic volume value					0		
(19) Sleep mode set	0	1	0	1	0	1	1	0	0	0	0	1	0: Sleep mode, 1: Normal mode
(20) Booster ratio set	0	1	0	1	1	1	1	1	0	0	0	0	select booster ratio 00: 2x,3x,4x 01: 5x 11: 6x
(21) NOP	0	1	0	1	1	1	0	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

```
'-----  
Sub Init  
Reset P3.7          'set Read/write to '0' for write  
Reset P3.0          'RS  
Set P3.1            'reset  
Reset P3.4 'E  
'Set P3.3  
'Reset P3.3  
Waitms 2  
'Set P3.3  
Waitms 20  
A = &HA2            '1/9 BIAS  
Call Writecom  
A = &HA0            'ADC SELECT , NORMAL  
Call Writecom  
A = &HC8            'COM OUTPUT REVERSE  
Call Writecom  
A = &HA4            'DISPLAY ALL POINTS NORMAL  
Call Writecom  
A = &H40            'DISPLAY START LINE SET  
Call Writecom  
A = &H25            'INTERNAL RESISTOR RATIO  
Call Writecom  
A = &H81            'ELECTRONIC VOLUME MODE SET  
Call Writecom  
A = &H10            'ELECTRONIC VOLUME  
Call Writecom  
A = &H2F            'POWER CONTROLLER SET  
Call Writecom  
A = &HAF            'DISPLAY ON  
Call Writecom  
End Sub
```

```
'-----  
Sub Writecom  
Reset P3.0          'A0 low  
Reset P3.7          'R/W low  
Set P3.6            'CS1  
Set P3.4            'E  
P1 = A  
Reset P3.4  
Reset P3.6  
Reset P3.7  
End Sub
```

```
Sub Writedata  
Set P3.0            'A0 high  
Reset P3.7          'R/W low  
Set P3.6            'CS1  
Set P3.4            'E  
P1 = A  
Reset P3.4  
Reset P3.6  
Reset P3.7  
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 , 240hrs	2
Low Temperature storage	Endurance test applying the low storage temperature for a long time.	-30°C , 240hrs	1,2
High Temperature Operation	Endurance test applying the electric stress (voltage & current) and the high thermal stress for a long time.	+70°C 240hrs	2
Low Temperature Operation	Endurance test applying the electric stress (voltage & current) and the low thermal stress for a long time.	-20°C , 240hrs	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.	+40°C , 90% RH , 240hrs	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.

See full Quality Specification at [http://www.newhavendisplay.com/specs/quality\\_spec.pdf](http://www.newhavendisplay.com/specs/quality_spec.pdf)

## Assembly Reliability Information

Test Item	Content of Test	Test Condition	Result	Note
High Temperature test on adhesive	Endurance of backlight adhesive applying high temperature for a long time.	60°C, 50% RH, 240hrs	>50N to separate backlight from LCD	1,2
Vibration test on adhesive	Endurance of backlight adhesive applying vibration to simulate transportation and use.	30Hz, 10min 35Hz, 10min 40Hz, 20min 45Hz, 20min	>50N to separate backlight from LCD	3
Drop test on adhesive	Endurance of backlight adhesive applying drop force to simulate transportation and use.	Corner: 25cm, 1 drop Edge: 25cm, 1 drop Face: 100cm, 1 drop	>50N to separate backlight from LCD	4

**Note 1:** No condensation to be observed.

**Note 2:** Conducted immediately after test condition.

**Note 3:** Test performed on product itself, not inside a container.

**Note 4:** Test performed inside standard shipping packaging.

## Precautions for using LCDs/LCMs

See Precautions at [www.newhavendisplay.com/specs/precautions.pdf](http://www.newhavendisplay.com/specs/precautions.pdf)

## Warranty Information and Terms & Conditions

[http://www.newhavendisplay.com/index.php?main\\_page=terms](http://www.newhavendisplay.com/index.php?main_page=terms)

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