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# NHD-C12864LZ-NSW-FBW-3V3

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

NHD-	Newhaven Display
C12864-	128 x 64 Pixels
LZ-	Model
N-	Transmissive
SW-	Side White LED Backlight
F-	FSTN, Negative
B-	6:00 Optimal View
W-	Wide Temperature
3V3-	3V LCD, 3V Backlight
	<b>RoHS Compliant</b>

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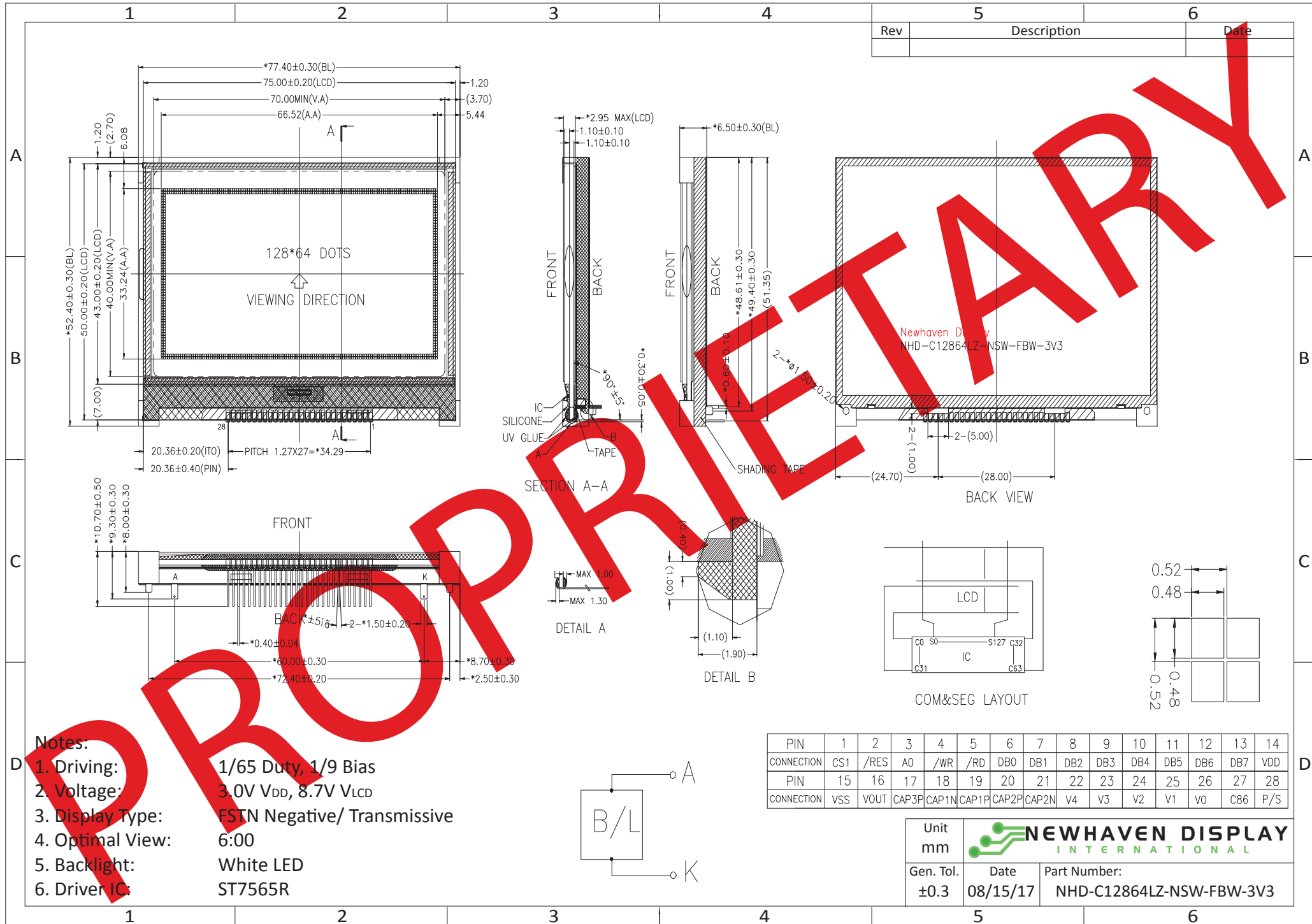
## Document Revision History

Revision	Date	Description	Changed by
0	10/12/16	Initial Release	AK
1	8/15/17	Backlight Redesign	SB

## Functions and Features

- 128 x 64 pixels
- Parallel / Serial MPU interface
- Built-in ST7565R-G Controller
- +3.0V power supply
- 1/65 duty cycle; 1/9 bias
- RoHS Compliant

# Mechanical Drawing



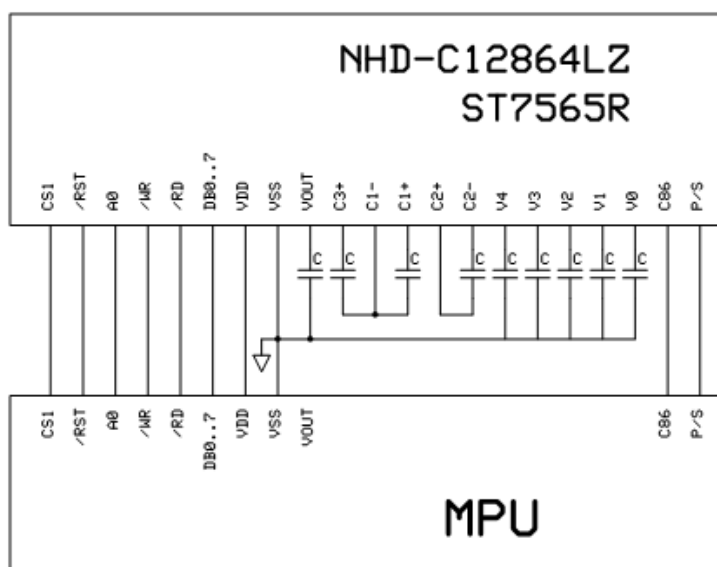
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## Pin Description and Wiring Diagram

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 register
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	DB0	MPU	Parallel Interface DB0-DB7: Bi-directional 8-bit data bus
7	DB1		
8	DB2		
9	DB3		
10	DB4		
11	DB5		
12	DB6		
13	DB7	MPU	Serial Interface: DB0-DB5: No connect in serial mode DB6= Serial clock (SCL) DB7= Serial data input (SI)
14	V <sub>DD</sub>	Power Supply	Supply Voltage for LCD and logic (+3.0V)
15	V <sub>SS</sub>	Power Supply	Ground
16	V <sub>OUT</sub>	Power Supply	Connect to 1uF cap to V <sub>SS</sub>
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	V <sub>4</sub>	Power Supply	1.0uF-2.2uF cap to V <sub>SS</sub>
23	V <sub>3</sub>	Power Supply	1.0uF-2.2uF cap to V <sub>SS</sub>
24	V <sub>2</sub>	Power Supply	1.0uF-2.2uF cap to V <sub>SS</sub>
25	V <sub>1</sub>	Power Supply	1.0uF-2.2uF cap to V <sub>SS</sub>
26	V <sub>0</sub>	Power Supply	1.0uF-2.2uF cap to V <sub>SS</sub>
27	C86	MPU	MPU interface Select pin. C86=H: 6800; C86=L: 8080
28	PS	MPU	Parallel/Serial select. PS= H: Parallel; PS=L: Serial

**LCD connector:** 1.27mm pitch pins.

**Backlight connector:** 1.5mm wide pins.



## 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	0.5	2.0	mA
Supply for LCD (contrast)	$V_{DD} - V_0$	$T_{OP} = 25^{\circ}C$	8.4	8.7	9.0	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	$V_{OL}$	-	$V_{SS}$	-	$0.2 * V_{SS}$	V
LED Backlight current	$I_{LED}$	-	-	80	100	mA
LED Backlight voltage	$V_{LED}$	$I_{LED} = 80mA$	2.7	3.0	3.3	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	$Cr \geq 2$	-	35	-	°
	Bottom		-	35	-	°
	Left		-	40	-	°
	Right		-	40	-	°
Contrast Ratio	CR	-	2	5	-	-
Response Time	Rise	$T_{OP} = 25^{\circ}C$	-	150	250	ms
	Fall		-	200	300	ms

## Controller Information

Built-in ST7565R-G controller.

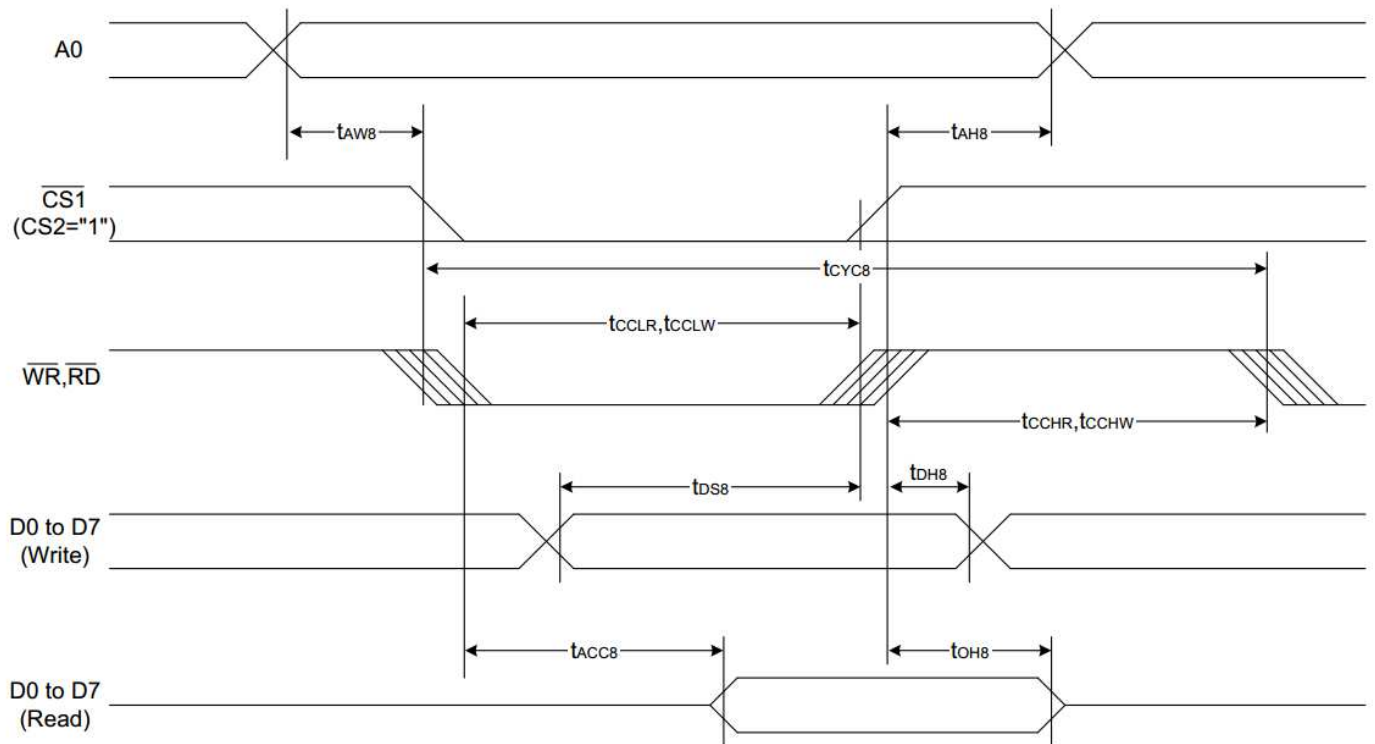
Please download specification at [http://www.newhavendisplay.com/app\\_notes/ST7565R.pdf](http://www.newhavendisplay.com/app_notes/ST7565R.pdf)

## 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.	
Column address set lower bit				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 (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	1	0	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		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		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							
(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	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

# Timing Characteristics

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

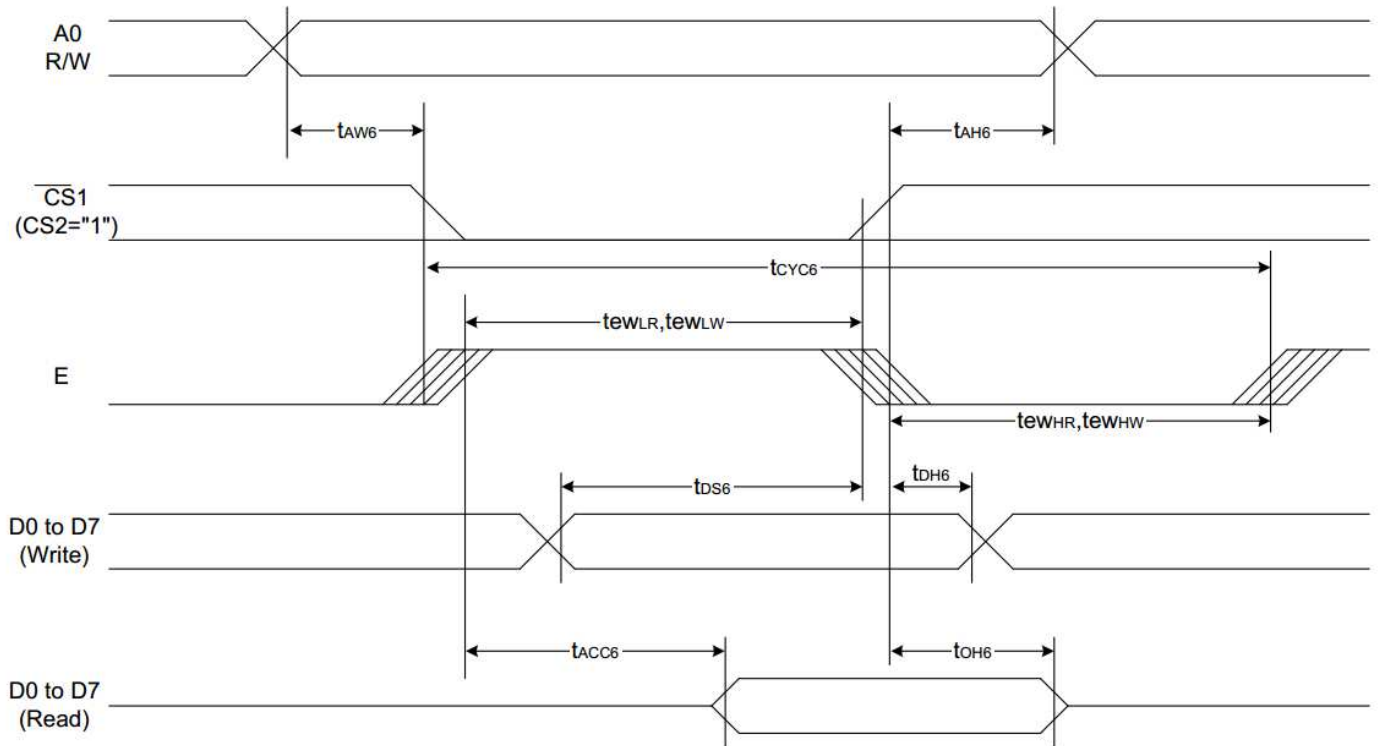


(V<sub>DD</sub> = 3.3V, T<sub>a</sub> = -30 to 85°C)

Item	Signal	Symbol	Condition	Rating		Units
				Min.	Max.	
Address hold time	A0	t <sub>AH8</sub>		0	—	Ns
Address setup time		t <sub>AW8</sub>		0	—	
System cycle time		t <sub>CYC8</sub>		240	—	
Enable L pulse width (WRITE)	WR	t <sub>cCLW</sub>		80	—	
Enable H pulse width (WRITE)		t <sub>cCHW</sub>		80	—	
Enable L pulse width (READ)	RD	t <sub>cCLR</sub>		140	—	
Enable H pulse width (READ)		t <sub>cCHR</sub>		80	—	
WRITE Data setup time	D0 to D7	t <sub>DS8</sub>		40	—	
WRITE Address hold time		t <sub>DH8</sub>		0	—	
READ access time		t <sub>ACC8</sub>	CL = 100 pF	—	70	
READ Output disable time		t <sub>OH8</sub>	CL = 100 pF	5	50	



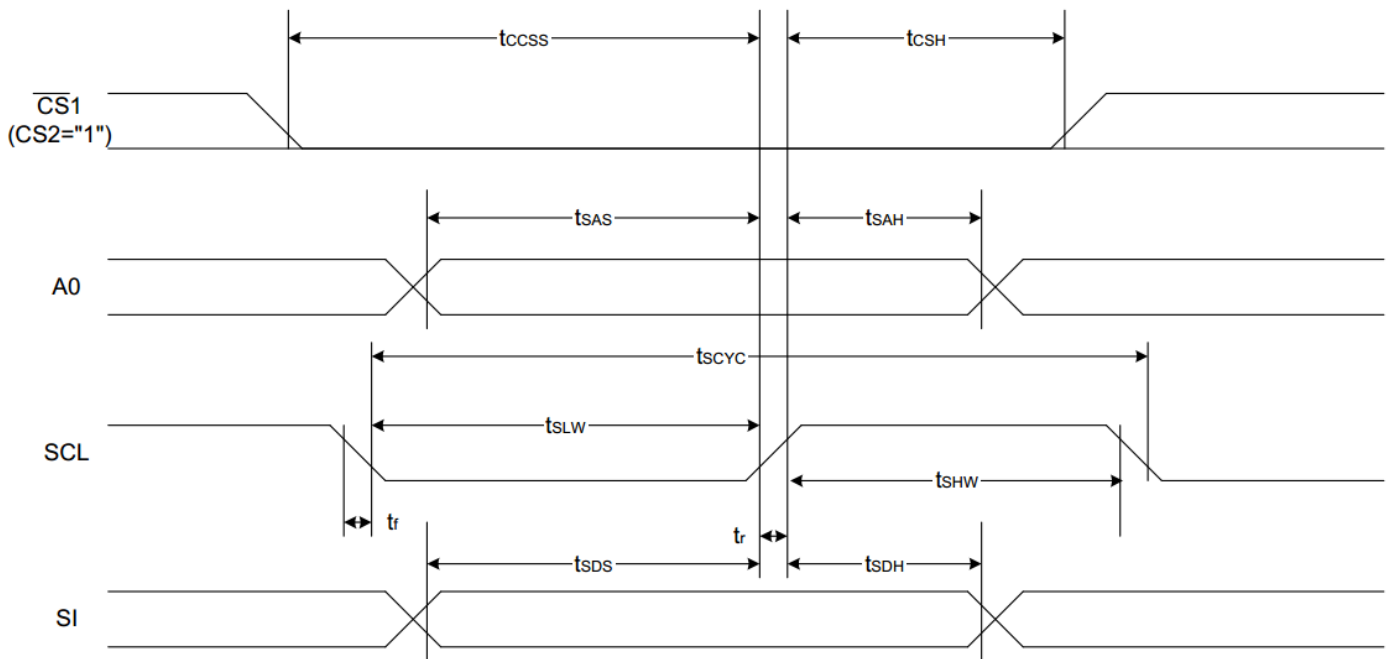
## System Bus Read/Write Characteristics 2 (For the 6800 Series MPU)



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

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)	WR	$t_{EHLW}$		80	—	
Enable H pulse width (WRITE)		$t_{EHW}$		80	—	
Enable L pulse width (READ)	RD	$t_{EHLR}$		80	—	
Enable H pulse width (READ)		$t_{EHR}$		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



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

Item	Signal	Symbol	Condition	Rating		Units
				Min.	Max.	
4-line SPI Clock Period	SCL	$T_{\text{scyc}}$		50	—	ns
SCL "H" pulse width		$T_{\text{shw}}$		25	—	
SCL "L" pulse width		$T_{\text{SLW}}$		25	—	
Address setup time	A0	$T_{\text{SAS}}$		20	—	
Address hold time		$T_{\text{sah}}$		10	—	
Data setup time	SI	$T_{\text{sds}}$		20	—	
Data hold time		$T_{\text{SDH}}$		10	—	
CS-SCL time	CS	$T_{\text{css}}$		20	—	
CS-SCL time		$T_{\text{csh}}$		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
    delay(5);
}

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

void init()
{
    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 (AO=Normal)
    comm_out(0xC8);  //added
    comm_out(0xC0);  //COM output scan direction (C0= Normal)
    comm_out(0x40);  //Operating Mode
    delay(0);
    comm_out(0x25);  //resistor ratio
    delay(0);

    comm_out(0x81);  //electronic volume mode set
    delay(0);
    comm_out(0x19);  //electronic volume register set
    delay(0);
    comm_out(0x2F);  //power control set
    delay(0);
    comm_out(0xAF);  //display ON/OFF - set to ON
}
```

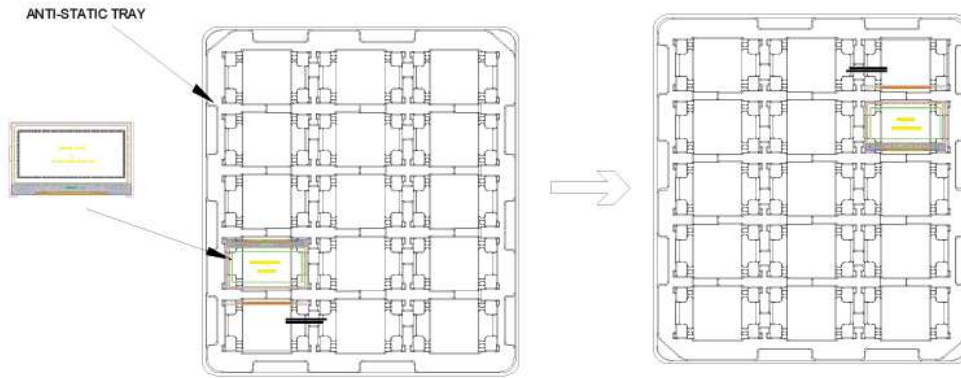
# Packing Procedure

## 1. Packing Materials

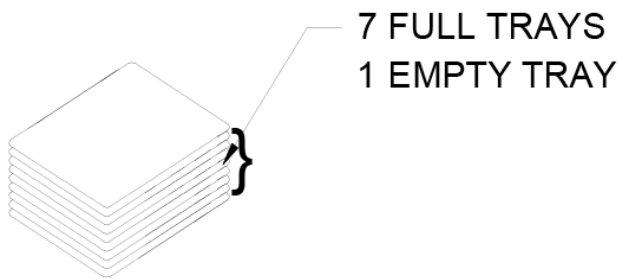
NO.	Item	Dimensions (LxWxH) (mm)	Quantity
1	Tray	366x296x21.1	15
2	Box	382x310x165	105
3	Carton	400x321x363	210

## 2. Packing Method

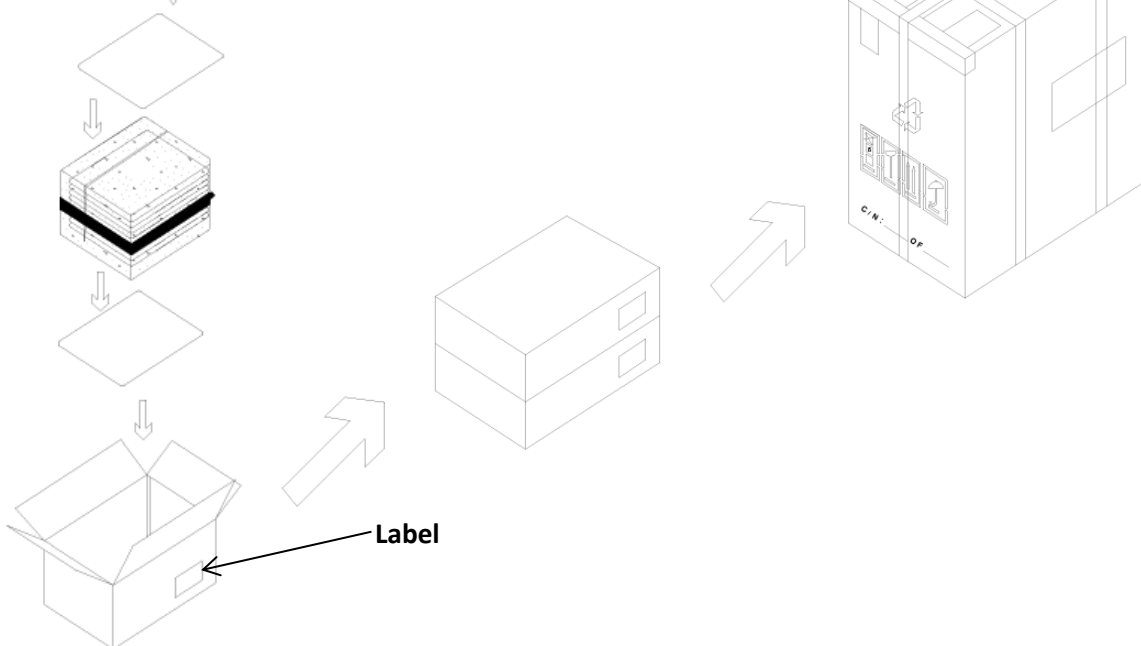
### A. Place display on the tray & Rotate Stacked trays by 180°



### B.



### C.



## 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 , 96hrs	2
Low Temperature storage	Endurance test applying the low storage temperature for a long time.	-30°C , 96hrs	1,2
High Temperature Operation	Endurance test applying the electric stress (voltage & current) and the high thermal stress for a long time.	+70°C 96hrs	2
Low Temperature Operation	Endurance test applying the electric stress (voltage & current) and the low thermal stress for a long time.	-20°C , 96hrs	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.	-0°C,30min -> 25°C,5min -> 50°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=±8kV Air, ±4kV Touch Five 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](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)