

NHD-C12864LZ-FSW-FBW-3V3

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

NHD-	Newhaven Display
C12864-	128 x 64 Pixels
LZ-	Model
F-	Transflective
SW-	Side White LED backlight
F-	FSTN (+)
B-	6:00 Optimal View
W-	Wide Temperature
3V3-	3Vdd, 3V Backlight
	RoHS Compliant

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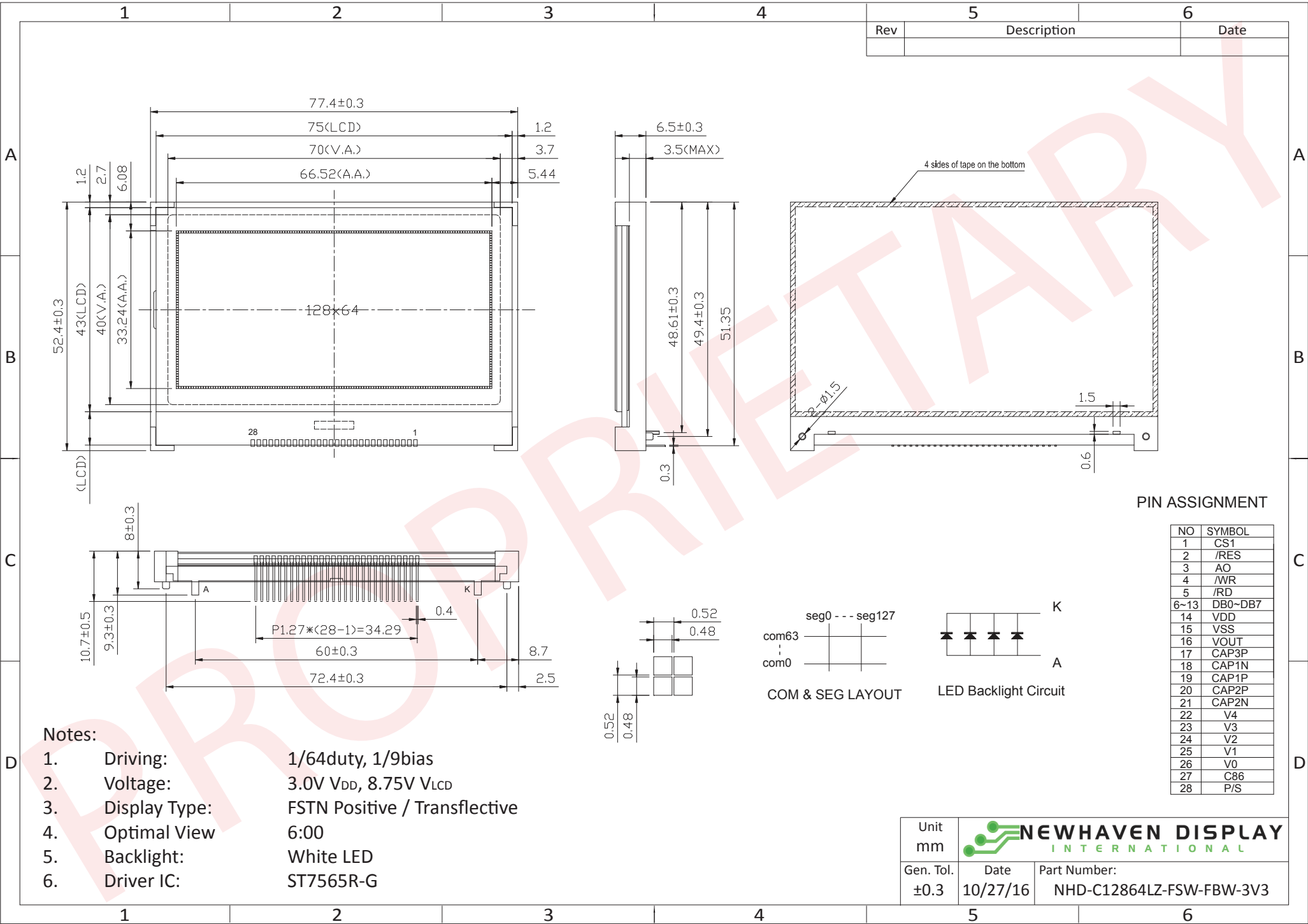
Document Revision History

Revision	Date	Description	Changed by
0	1/10/2010	Initial Release	MC
1	7/7/2011	Packaging Procedure added	AK
2	12/12/2012	Example initialization program updated	AK
3	4/10/2013	Serial interface timing added	AK
4	3/17/2015	Pin Description updated	RM
5	10/16/2015	Mechanical Drawing Updated	TJ
6	6/29/16	Electrical and Optical Characteristics Updated	SB
7	10/27/16	Electrical Characteristics and Mechanical Drawing Updated	TM

Functions and Features

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

Mechanical Drawing

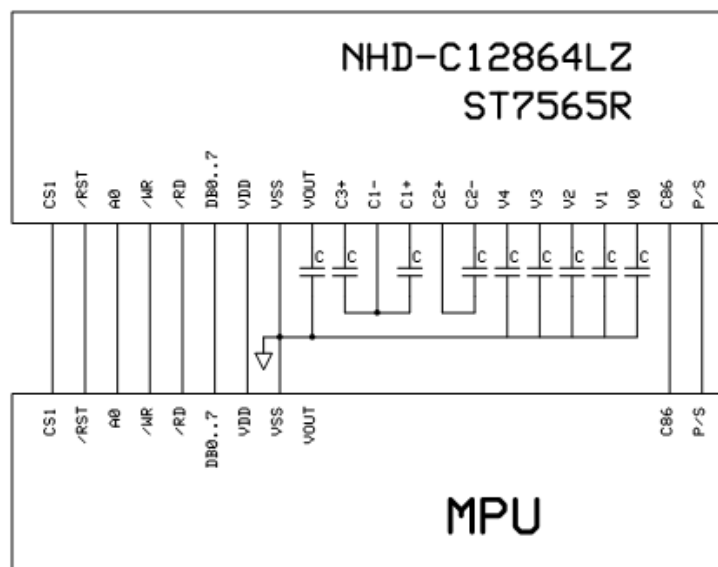


Pin Description and Wiring Diagram

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 Serial Interface: DB0-DB5: No connect in serial mode DB6= Serial clock (SCL) DB7= Serial data input (SI)
7	DB1	MPU	
8	DB2	MPU	
9	DB3	MPU	
10	DB4	MPU	
11	DB5	MPU	
12	DB6	MPU	
13	DB7	MPU	
14	V _{DD}	Power Supply	Supply Voltage for LCD and logic (+3.0V)
15	V _{SS}	Power Supply	Ground
16	V _{OUT}	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	V ₄	Power Supply	1.0uF-2.2uF cap to VSS
23	V ₃	Power Supply	1.0uF-2.2uF cap to VSS
24	V ₂	Power Supply	1.0uF-2.2uF cap to VSS
25	V ₁	Power Supply	1.0uF-2.2uF cap to VSS
26	V ₀	Power Supply	1.0uF-2.2uF cap to VSS
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}	$V_{DD} = 3.0V$ $T_{OP} = 25^{\circ}C$	0.25	0.5	1.0	mA
Supply for LCD (contrast)	V_{LCD}		8.4	8.7	9.0	V
"H" Level input	V_{IH}	-	$0.8 \cdot V_{DD}$	-	V_{DD}	V
"L" Level input	V_{IL}	-	VSS	-	$0.2 \cdot V_{DD}$	V
"H" Level output	V_{OH}	-	$0.8 \cdot V_{DD}$	-	V_{DD}	V
"L" Level output	V_{OL}	-	VSS	-	$0.2 \cdot V_{SS}$	V
LED Backlight voltage	V_{LED}	-	2.7	3.0	3.3	V
LED Backlight current	I_{LED}	$V_{LED} = 3.0V$	60	80	100	mA

Optical Characteristics

Item		Symbol	Condition	Min.	Typ.	Max.	Unit
Optimal Viewing Angles	Top	$\phi Y+$	$Cr \geq 2$	-	40	-	°
	Bottom	$\phi Y-$		-	60	-	°
	Left	$\theta X-$		-	60	-	°
	Right	$\theta X+$		-	60	-	°
Contrast Ratio		CR	-	2	5	-	-
Response Time	Rise	T_F	$T_{OP} = 25^{\circ}C$	-	150	250	ms
	Fall	T_F		-	200	300	ms

Controller Information

Built-in ST7565R-G controller.

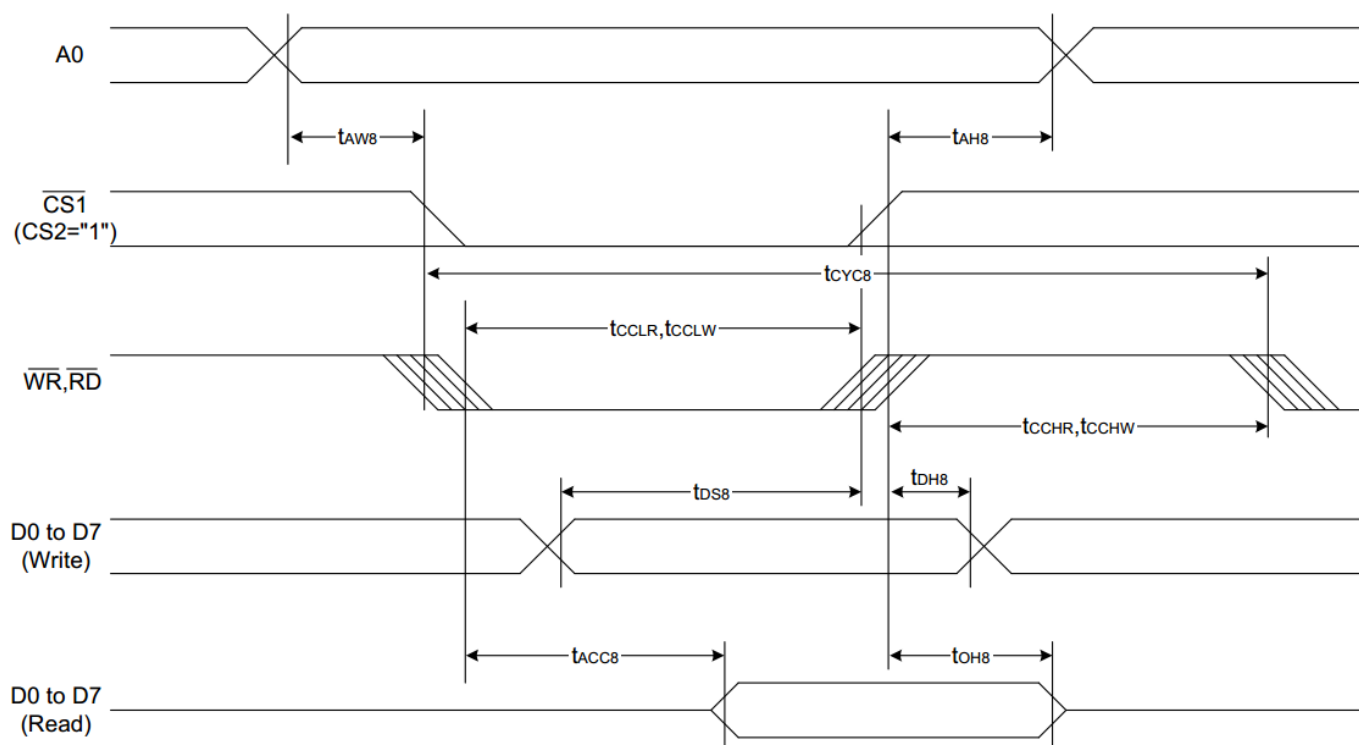
Please download specification at http://www.newhavendisplay.com/app_notes/ST7565R.pdf

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 Column address set lower bit	0	1	0	0	0	0	1	Most significant column address			Sets the most significant 4 bits of the display RAM column address.	
				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	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	*	*	*	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 Electronic volume register set	0	1	0	1	0	0	0	0	0	0	1	Set the V ₀ output voltage electronic volume register
				0	0	Electronic volume value						
(19) Sleep mode set	0	1	0	1	0	1	0	1	1	0	0 1	0: Sleep mode, 1: Normal mode
				*	*	*	*	*	*	0	0	
(20) Booster ratio set	0	1	0	1	1	1	1	1	0	0	0	select booster ratio 00: 2x,3x,4x 01: 5x 11: 6x
				0	0	0	0	0	0	0	step-up value	
(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

Timing Characteristics

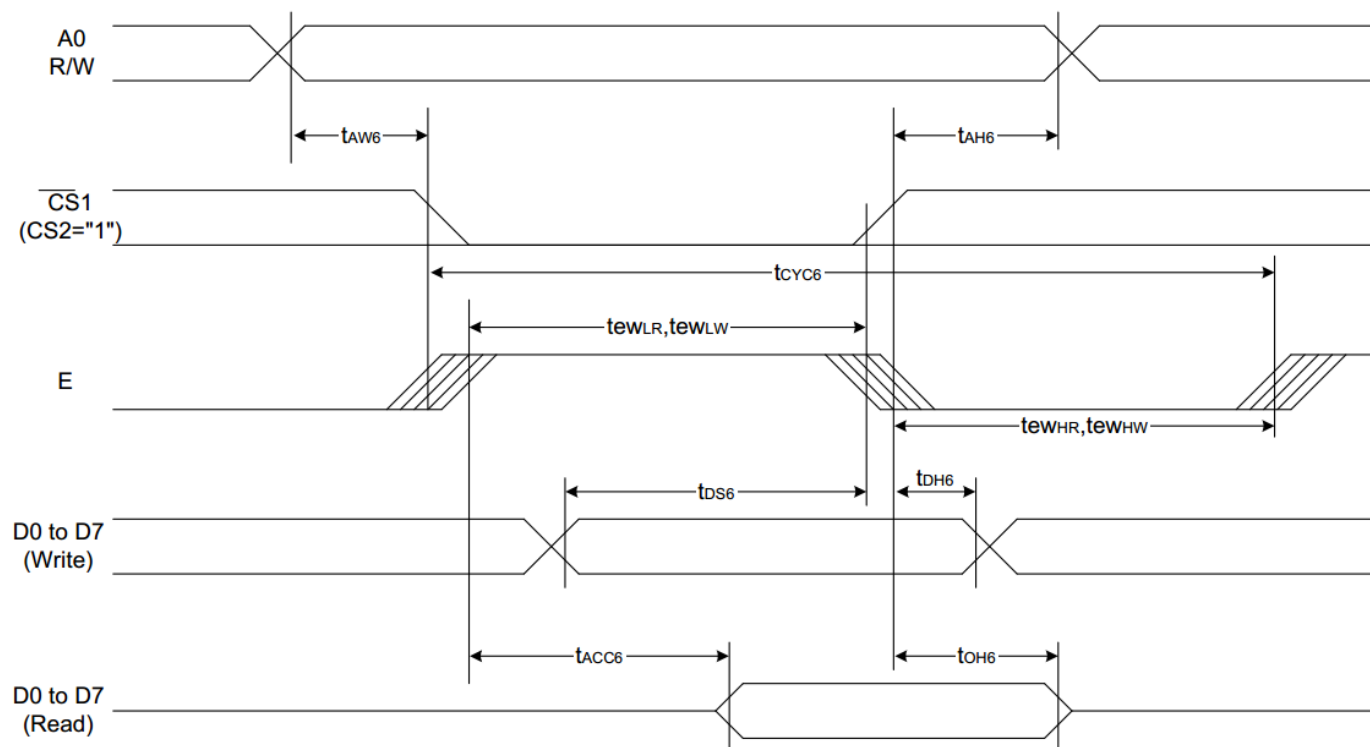
System Bus Read/Write Characteristics 1 (For the 8080 Series MPU)



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

Item	Signal	Symbol	Condition	Rating		Units
				Min.	Max.	
Address hold time	A0	t_{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_{CCHW}		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_{DS8}		40	—	
WRITE Address hold time		t_{DH8}		0	—	
READ access time		t_{ACC8}	$CL = 100 \text{ pF}$	—	70	
READ Output disable time		t_{OH8}	$CL = 100 \text{ pF}$	5	50	

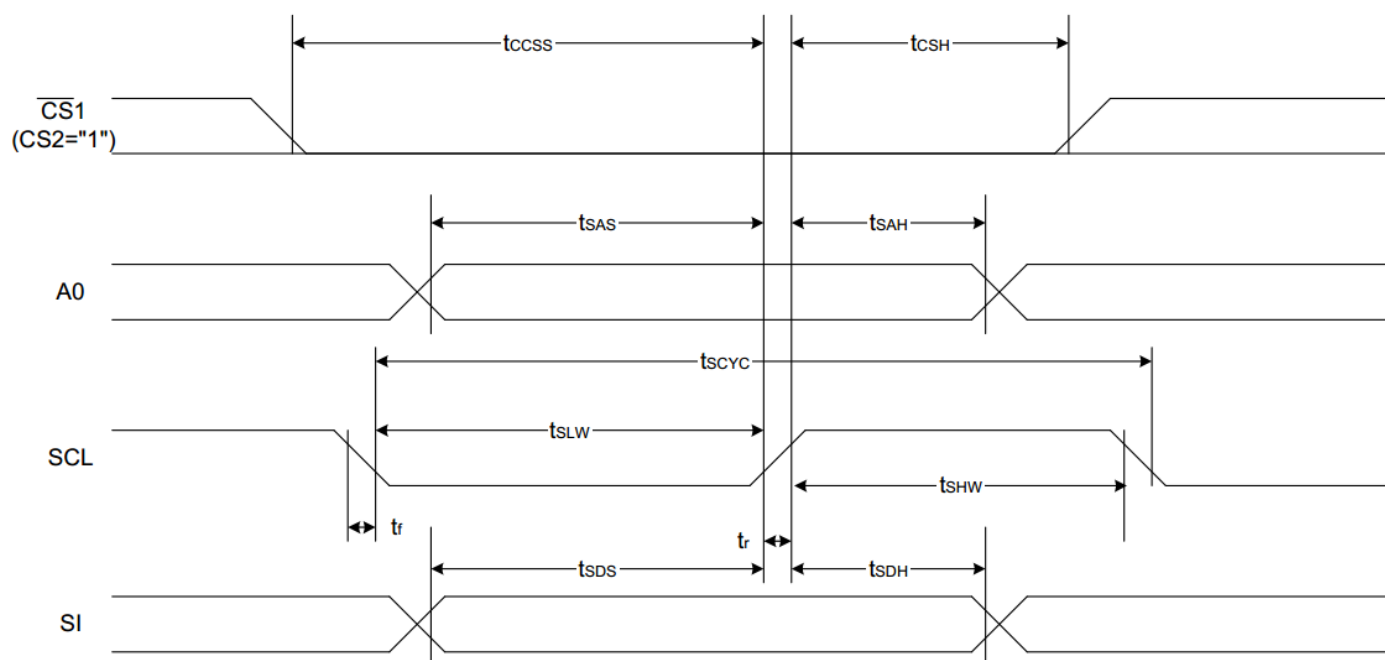
System Bus Read/Write Characteristics 2 (For the 6800 Series MPU)



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

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_{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}	$CL = 100 \text{ pF}$	—	70	
READ Output disable time		t_{OH6}	$CL = 100 \text{ pF}$	5	50	

The 4-line SPI Interface



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

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	—	

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 (A0=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
```

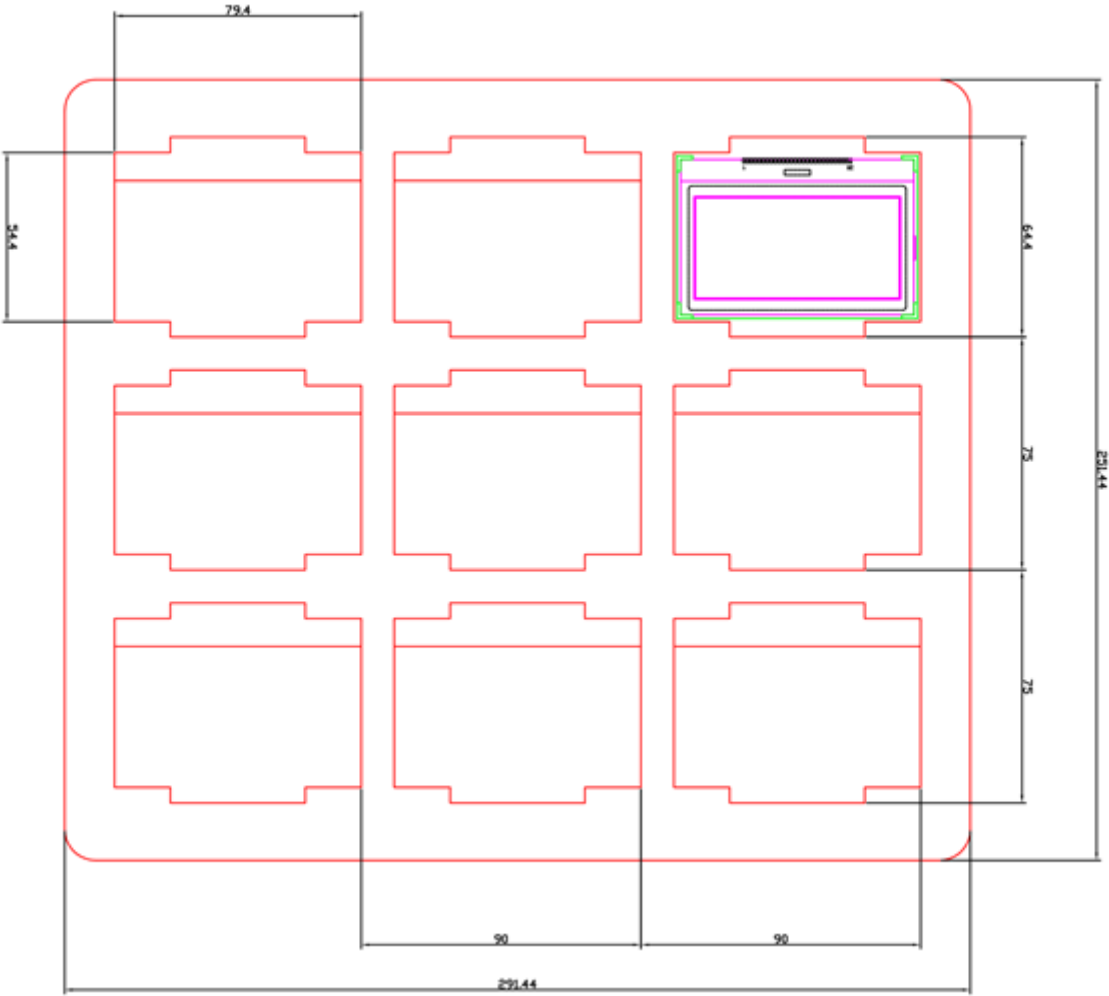
Packaging Procedure

1. Packing Materials

NO.	ITEM	Dimension(LXWXH) (mm)	Quantity
1	Tray	292x251x20mm	9
2	Box	312x265x65mm	27
3	Carton	344x537x335mm	270

2. Packing Method

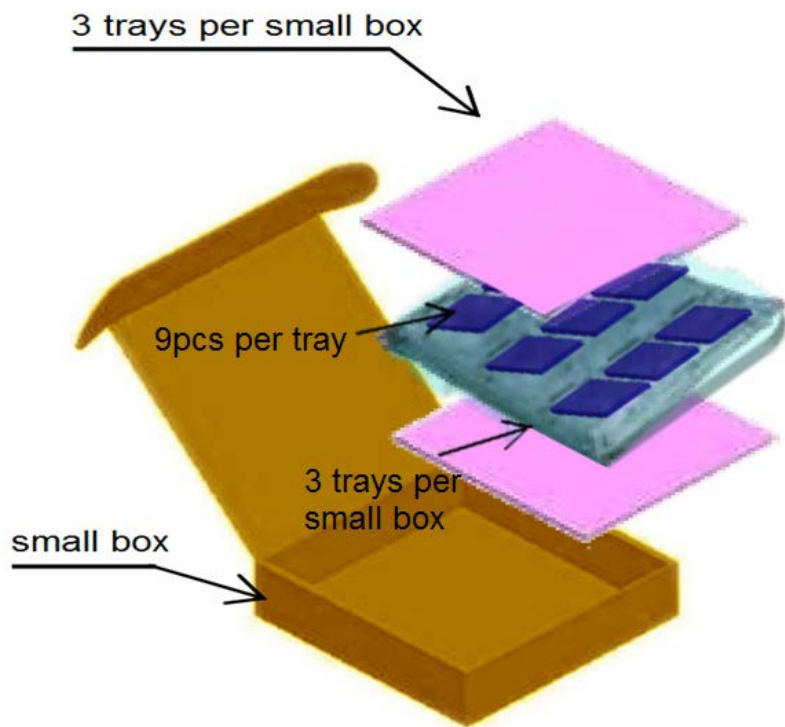
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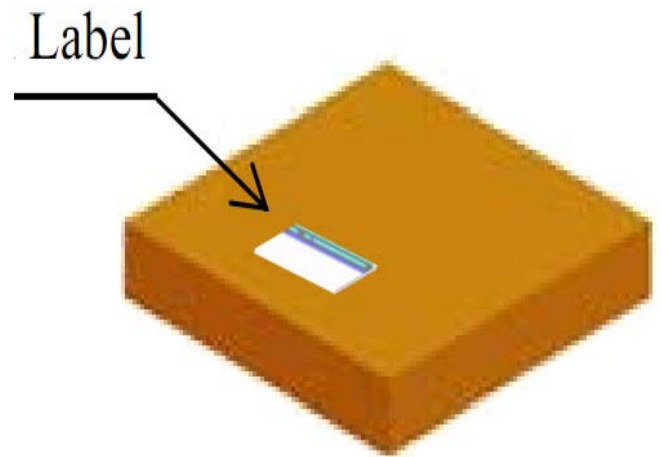
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(3)

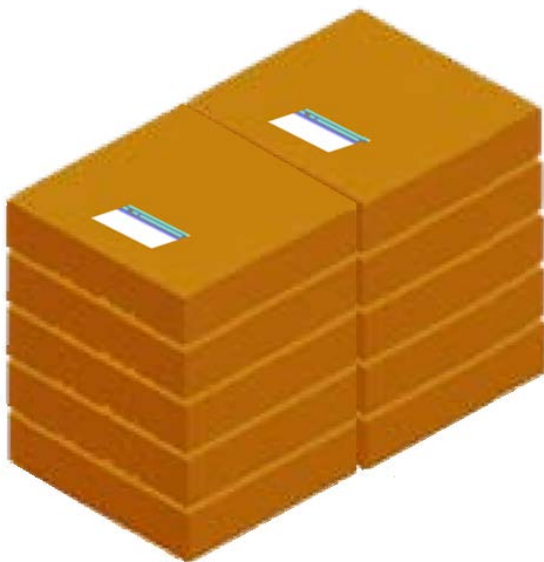


(4)

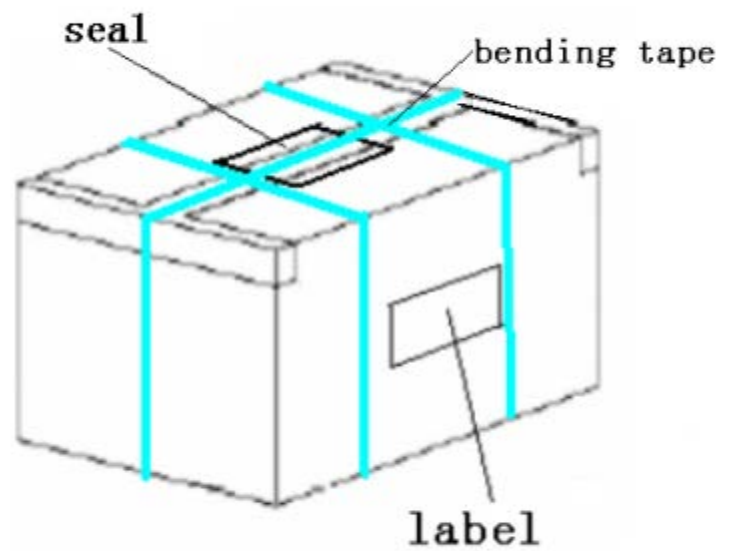


(5)

10 small boxes per carton



(6)



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 , 48hrs	2
Low Temperature storage	Endurance test applying the low storage temperature for a long time.	-30°C , 48hrs	1,2
High Temperature Operation	Endurance test applying the electric stress (voltage & current) and the high thermal stress for a long time.	+70°C , 48hrs	2
Low Temperature Operation	Endurance test applying the electric stress (voltage & current) and the low thermal stress for a long time.	-20°C , 48hrs	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 , 48hrs	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 For 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.	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

Precautions for using LCDs/LCMs

See Precautions at www.newhavendisplay.com/specs/precautions.pdf

Warranty Information

See Terms & Conditions at http://www.newhavendisplay.com/index.php?main_page=terms