

# NHD-C12864KGZ-FSW-GBW

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

NHD-	Newhaven Display
C12864-	128 x 64 Pixels
KGZ-	Model
F-	Transflective
SW-	Side White LED Backlight
G-	STN - Gray
B-	6:00 Optimal View
W-	Wide Temperature
	<b>RoHS Compliant</b>

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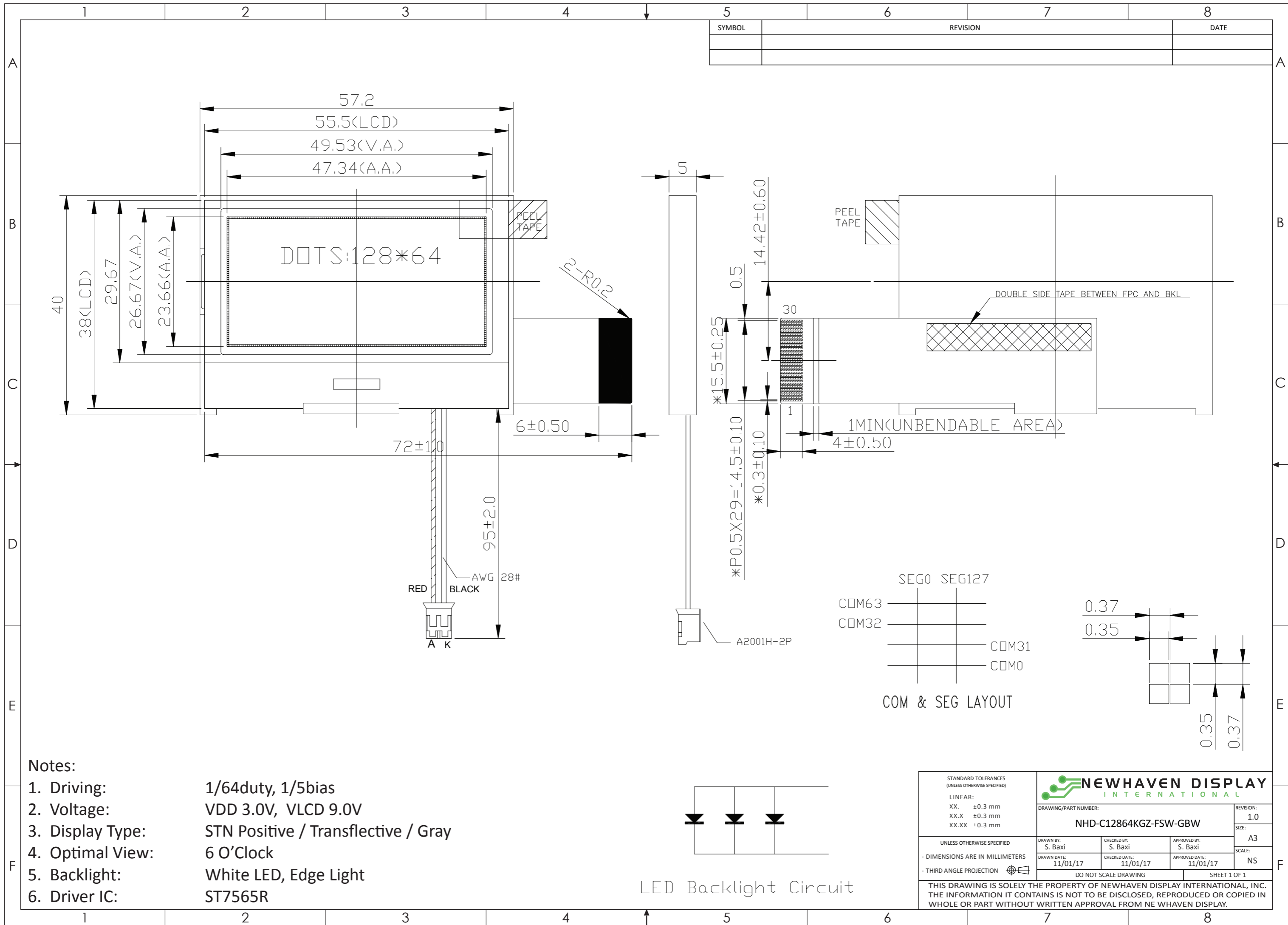
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## Document Revision History

Revision	Date	Description	Changed by
0	3/19/12	Initial Release	-
1	5/11/12	Electrical and Optical characteristics updated	AK
2	4/4/13	Backlight mating connector part number updated	AK
3	10/3/13	Example Code updated	ML
5	11/1/17	Mechanical Drawing and Electrical Characteristics Updated	SB

## Functions and Features

- 128 x 64 pixels
- Built-in ST7565R controller
- 1/65 duty, 1/9 bias
- Parallel 8080 MPU interface
- RoHS Compliant



SYMBOL	REVISION	DATE

- Notes:
- Driving: 1/64duty, 1/5bias
  - Voltage: VDD 3.0V, VLCD 9.0V
  - Display Type: STN Positive / Transflective / Gray
  - Optimal View: 6 O'Clock
  - Backlight: White LED, Edge Light
  - Driver IC: ST7565R

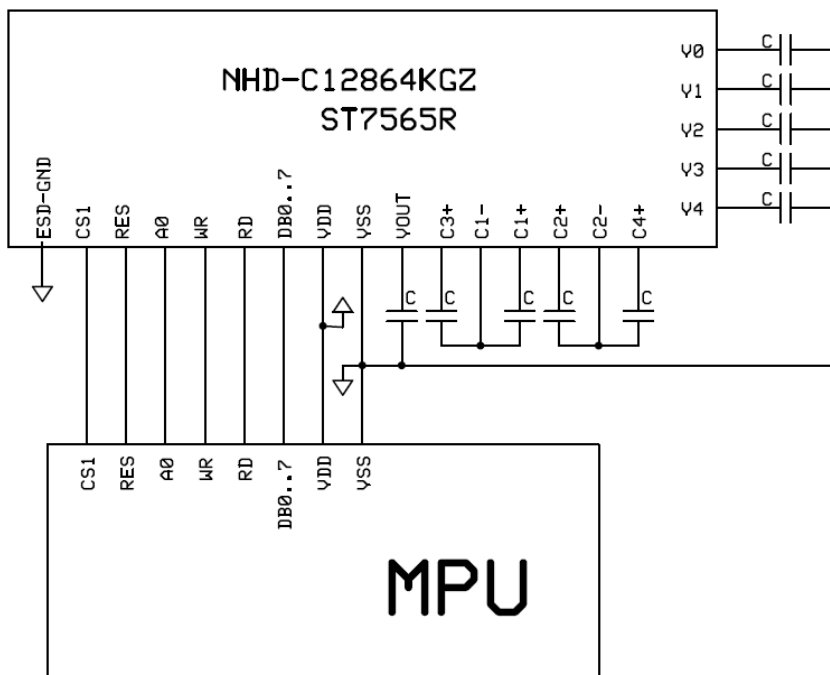
STANDARD TOLERANCES (UNLESS OTHERWISE SPECIFIED)			
LINEAR:		DRAWING/PART NUMBER:	
XX. ±0.3 mm		NHD-C12864KGZ-FSW-GBW	
XX.X ±0.3 mm		REVISION: 1.0	
XX.XX ±0.3 mm		SIZE: A3	
UNLESS OTHERWISE SPECIFIED		SCALE: NS	
- DIMENSIONS ARE IN MILLIMETERS		DO NOT SCALE DRAWING	
- THIRD ANGLE PROJECTION		SHEET 1 OF 1	
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## Pin Description and Wiring Diagram

Pin No.	Symbol	External Connection	Function Description
1	ESD-GND	Power Supply	Ground (can be a No Connect)
2	/CS1	MPU	Active LOW Chip Select signal
3	/RES	MPU	Active LOW Reset signal
4	A0	MPU	Register Select: '0' = Command, '1' = Data
5	/WR	MPU	Active LOW Write signal
6	/RD	MPU	Active LOW Read signal
7-14	D0-D7	MPU	8-bit bi-directional data bus
15	V <sub>DD</sub>	Power Supply	Supply Voltage for LCD and Logic (3.0V)
16	V <sub>SS</sub>	Power Supply	Ground
17	V <sub>OUT</sub>	Power Supply	1.0uF-2.2uF Capacitor to V <sub>SS</sub>
18	C <sub>3+</sub>	Power Supply	1.0uF-2.2uF Capacitor to C1- (Pin-19)
19	C <sub>1-</sub>	Power Supply	1.0uF-2.2uF Capacitor to C3+ (Pin-18) and C1+ (Pin-20)
20	C <sub>1+</sub>	Power Supply	1.0uF-2.2uF Capacitor to C1- (Pin-19)
21	C <sub>2+</sub>	Power Supply	1.0uF-2.2uF Capacitor to C2- (Pin-22)
22	C <sub>2-</sub>	Power Supply	1.0uF-2.2uF Capacitor to C2+(Pin-21) and C4+ (Pin-23)
23	C <sub>4+</sub>	Power Supply	1.0uF-2.2uF Capacitor to C2- (Pin-22)
24	V <sub>4</sub>	Power Supply	0.1uF-1.0uF Capacitor to V <sub>DD</sub> or V <sub>SS</sub>
25	V <sub>3</sub>	Power Supply	0.1uF-1.0uF Capacitor to V <sub>DD</sub> or V <sub>SS</sub>
26	V <sub>2</sub>	Power Supply	0.1uF-1.0uF Capacitor to V <sub>DD</sub> or V <sub>SS</sub>
27	V <sub>1</sub>	Power Supply	0.1uF-1.0uF Capacitor to V <sub>DD</sub> or V <sub>SS</sub>
28	V <sub>0</sub>	Power Supply	0.1uF-1.0uF Capacitor to V <sub>DD</sub> or V <sub>SS</sub>
29	ESD-GND	Power Supply	Ground (can be a No Connect)
30	NC	-	No Connect

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

**Backlight connector:** A2001H-2P **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	$V_{DD}$	-	2.8	3.0	3.3	V
Supply Current	$I_{DD}$	$V_{DD}=3.0V$	0.2	0.5	1	mA
Supply for LCD (contrast)*	$V_{LCD}$	$T_{OP}=25^{\circ}C$	8.6	8.8	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	$V_{OL}$	-	$V_{SS}$	-	$0.2*V_{DD}$	V
Backlight Supply Current**	$I_{LED}$	-	-	60	90	mA
Backlight Supply Voltage	$V_{LED}$	$I_{LED}=60mA$	2.8	3.0	3.2	V

\*User should employ SW/HW methods for tuning contrast. (Refer to Electronic Volume Register)

\*\*The LED of the backlight is driven by current; 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	$\phi Y+$	-	40	-	°
	Bottom	$\phi Y-$	-	60	-	°
	Left	$\theta X-$	-	60	-	°
	Right	$\theta X+$	-	60	-	°
Contrast Ratio	CR	-	2	5	-	-
Response Time	Rise	$T_R$	-	150	250	ms
	Fall	$T_F$	-	200	300	ms

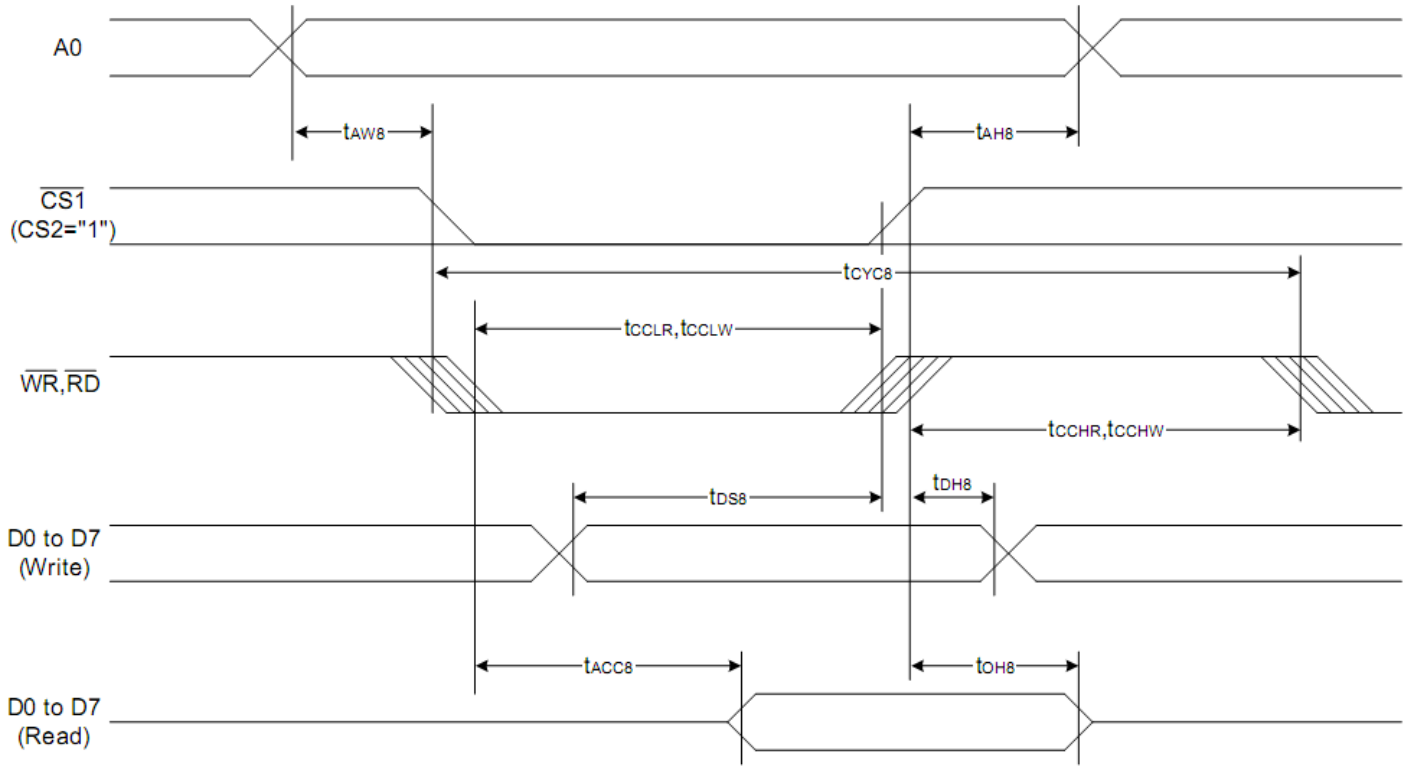
## Controller Information

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

## 8080 MPU Interface (VDD=3.3V)



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		$t_{ACC8}$	$C_L = 100 \text{ pF}$	—	70	
READ Output disable time		$t_{OH8}$	$C_L = 100 \text{ pF}$	5	50	

## 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						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	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	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	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	0	1	1	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
				0	0	0	0	0	0	0	step-up value		
(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 Code

```
/**
 *
 */

void comm_out(unsigned char c)
{
    CS1 = 0;
    AO = 0;           //LOW = command
    WRT = 0;
    P1 = c;
    WRT = 1;
    CS1 = 1;
}

/**
 *
 */

void data_out(unsigned char d)
{
    CS1 = 0;
    AO = 1;           //HIGH = data
    WRT = 0;
    P1 = d;
    WRT = 1;
    CS1 = 1;
}

/**
 *
 */

void disp()
{
    unsigned int i, j;
    unsigned char page=0xB0;
    for(i=0;i<8;i++)           //fill display with checkerboard pattern
    {
        comm_out(0x10);       //set column address
        comm_out(0x00);       //set column address
        comm_out(page);       //set page address
        for(j=0;j<64;j++)
        {
            data_out(0xAA);
            data_out(0x55);
        }
        page++;
    }
}

/**
 *
 */
```



```

/*****
/***** NHD-C12864KGZ DISPLAY INITIALIZATION *****/
/*****

void init()
{
    RDD = 1;
    WRT = 1;
    CS1 = 0;
    RST = 0;
    delay(150);
    RST = 1;
    delay(150);

    comm_out(0xA2); //added 1/9 bias
    comm_out(0xA0); //ADC segment driver direction (A0=Normal)
    comm_out(0xC0); //COM output scan direction (C0=Normal)
    comm_out(0x25); //resistor ratio
    comm_out(0x81); //electronic volume mode set
    comm_out(0x15); //electronic volume register set
    comm_out(0x2F); //operating mode
    comm_out(0x40); //start line set
    comm_out(0xAF); //display ON

    delay(10);
}

/*****

```

## 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.	+40°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 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.

## Precautions for using LCDs/LCMs

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

## Warranty Information

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