NEWHAVEN DISPLAY INTERNATIONAL

Product Specification

NHD-0208AZ-FSW-GBW-33V3

Character Liquid Crystal Display Module

NHD -	Newhaven Display
0208 -	2 Lines x 8 Characters
AZ -	Model
F -	Transflective
SW -	Side White LED Backlight
G -	STN Positive, Gray
B -	6:00 Optimal View
W -	Wide Temperature
33V3 -	3.3V LCD, 3.0V Backlight

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REACH Compliant

RoHS Compliant

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Additional Resources

- **Support Forum:** http://www.nhdforum.newhavendisplay.com
- **Github:** https://github.com/newhavendisplay
- **Example Code:** https://www.newhavendisplay.com/example_code.html
- **Knowledge Center:** https://www.newhavendisplay.com/knowledge_center.html
- **Quality Center:** https://www.newhavendisplay.com/quality_center.html
- **Precautions for using LCDs/LCMs:** https://www.newhavendisplay.com/specs/precautions.pdf
- **Warranty / Terms & Conditions:** https://www.newhavendisplay.com/terms.html

Document Revision History

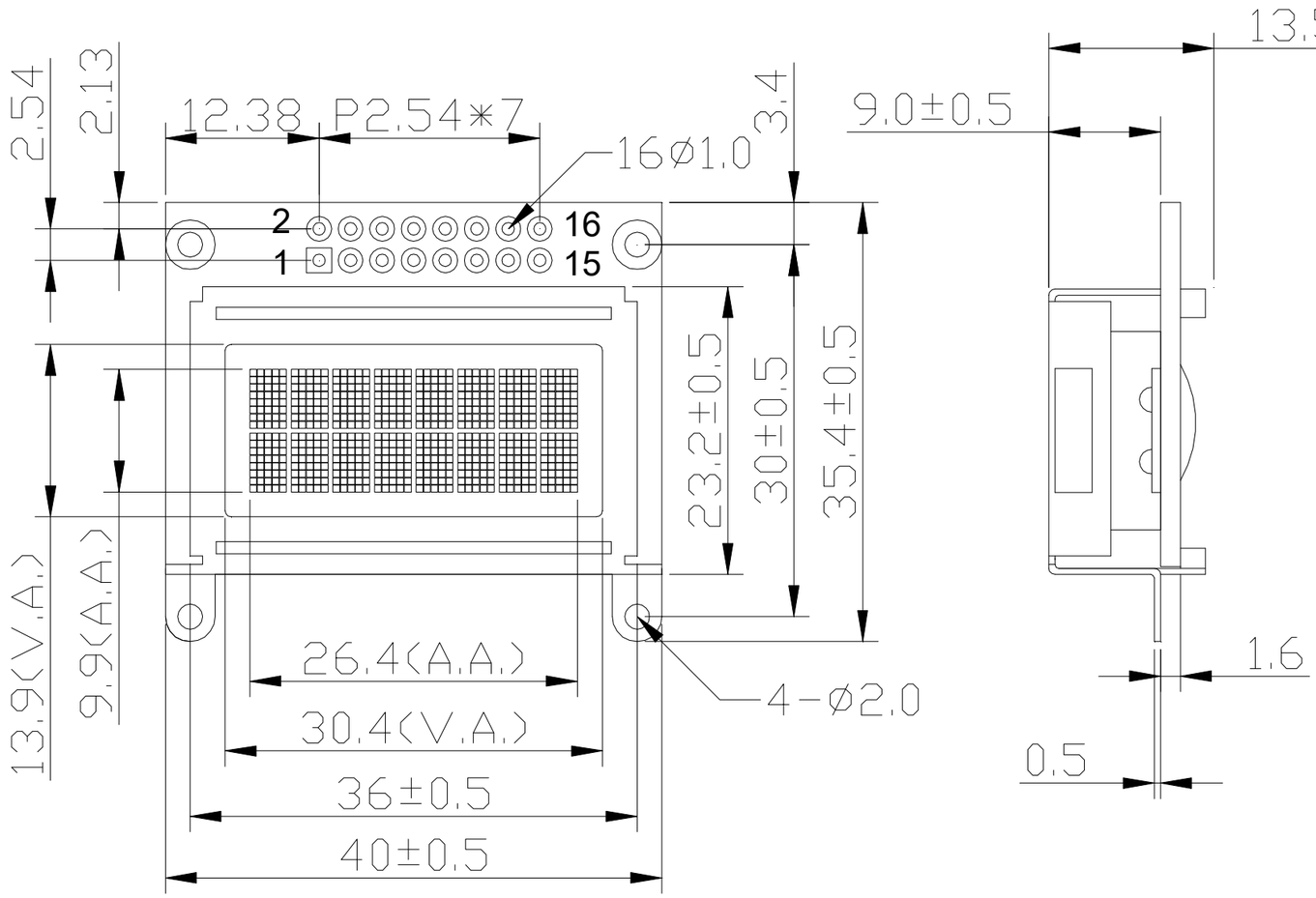
Revision	Date	Description	Changed By
0	10/31/2011	33V – improved liquid; VDD = 3.3V	SB
1	8/8/2012	Mechanical Drawing Updated	TJ
2	5/9/2014	Electrical/Optical char, Mechanical drawing updated	ML
3	4/25/16	Mechanical Drawing Updated	SB
4	5/26/16	Backlight Current Updated	SB
5	8/10/16	Backlight Voltage & Supply Current Updated	SB
6	6/28/17	Mechanical, Electrical & Optical Characteristics Updated	SB

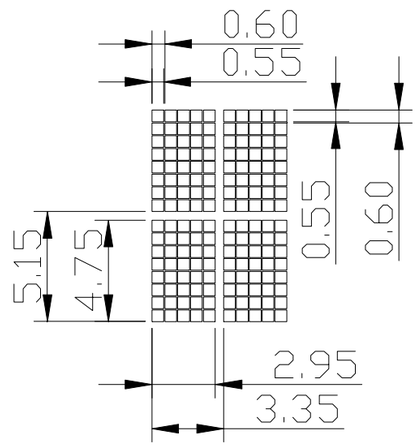
Functions and Features

- **2 lines x 8 characters**
- **Built-in controller (ST7066U)**
- **+3.3V power supply**
- **1/16 duty, 1/5 bias**
- **RoHS compliant**

Mechanical Drawing

SYMBOL	REVISION	DATE





PIN ASSIGNMENT

1	VSS
2	VDD
3	V0
4	RS
5	R/W
6	E
7~14	DB0~DB7
15	LED+
16	LED-

Notes:

1. Driver: 1/16 Duty, 1/5 Bias
2. Voltage: 3.3V V_{DD}, 3.3V V_{LCD}
3. Display Mode: STN Positive / Gray/ Transflective
4. Optimal View: 6:00
5. Backlight: White LED
6. Driver IC: ST7066U 8/4-Bit MPU Interface

Standard Tolerance:
(Unless otherwise specified)
Linear: ±0.3mm

NEWHAVEN DISPLAY INTERNATIONAL

Drawing/Part Number: NHD-0208AZ-FSW-GBW-33V3
Revision: 1.0

Unless otherwise specified:
• Dimensions are in Millimeters
• Third Angle Projection

Drawn By: K. Fraim
Approved By: A. Khan
Drawn Date: 06/28/17
Approved Date: 06/28/17
Size: A3
Scale: X:X

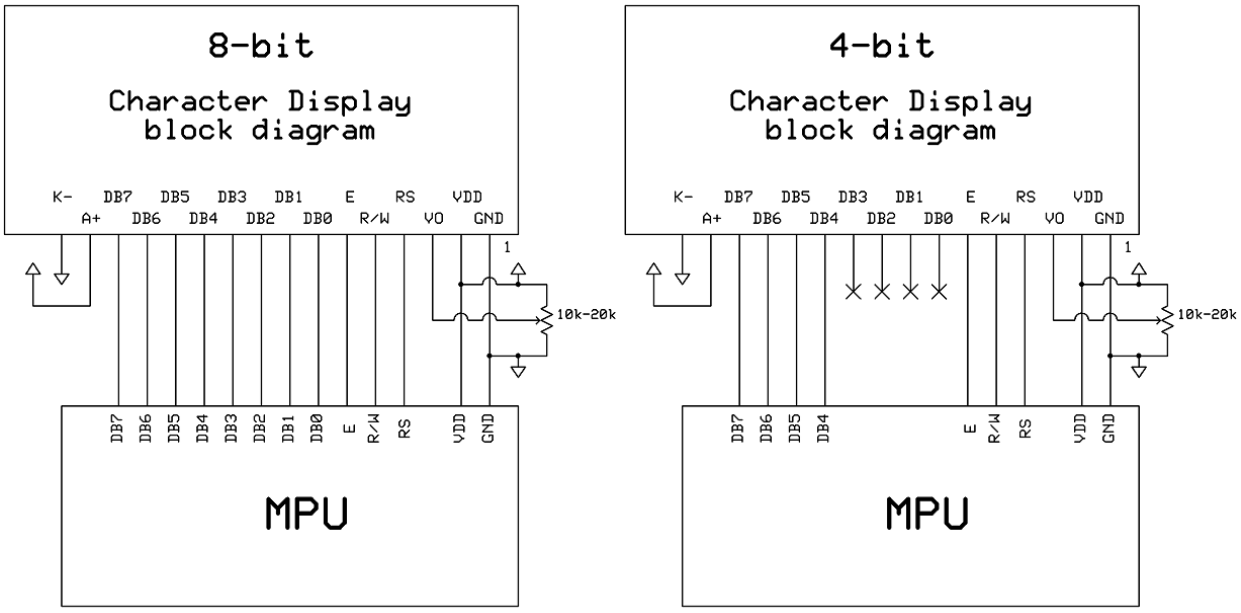
Do Not Scale Drawing
Sheet 1 of 1

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Pin Description and Wiring Diagram

Pin No.	Symbol	External Connection	Function Description
1	V_{SS}	Power Supply	Ground
2	V_{DD}	Power Supply	Supply Voltage for logic (+3.3V)
3	V_0	Adj. Power Supply	Supply Voltage for Contrast (approx. 0V)
4	RS	MPU	Register Select signal. RS=0: Command, RS=1: Data
5	R/W	MPU	Read/Write select signal, R/W=1: Read R/W: =0: Write
6	E	MPU	Operation Enable signal. Falling edge triggered.
7-10	DB0 – DB3	MPU	Four low order bi-directional three-state data bus lines. These four are not used during 4-bit operation.
11-14	DB4 – DB7	MPU	Four high order bi-directional three-state data bus lines.
15	LED+	Power Supply	Backlight Anode (15 mA @ 3V)
16	LED-	Power Supply	Backlight Cathode (Ground)

Recommended LCD connector: 2x8 2.54mm pitch connector
Backlight connector: --- **Mates with**: ---



Controller Information

Built-in ST7066U controller.
Please download specification at http://www.newhavendisplay.com/app_notes/ST7066U.pdf

DDRAM Address

1	2	3	4	5	6	7	8
00	01	02	03	04	05	06	07
40	41	42	43	44	45	46	47

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}	-	3.1	3.3	3.5	V
Supply Current	I_{DD}	V_{DD} = 3.3V	0.5	1.5	3.0	mA
Supply for LCD (contrast)	V_{LCD}	T_{OP} = 25°C	3.1	3.3	3.5	V
"H" Level input	V_{IH}	-	0.7*V_{DD}	-	V_{DD}	V
"L" Level input	V_{IL}	-	V_{SS}	-	0.6	V
"H" Level output	V_{OH}	-	3.9	-	V_{DD}	V
"L" Level output	V_{OL}	-	V_{SS}	-	0.4	V
Backlight Supply Current	I_{LED}	-	-	15	20	mA
Backlight Supply Voltage	V_{LED}	I_{LED} = 15mA	2.8	3.0	3.2	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:

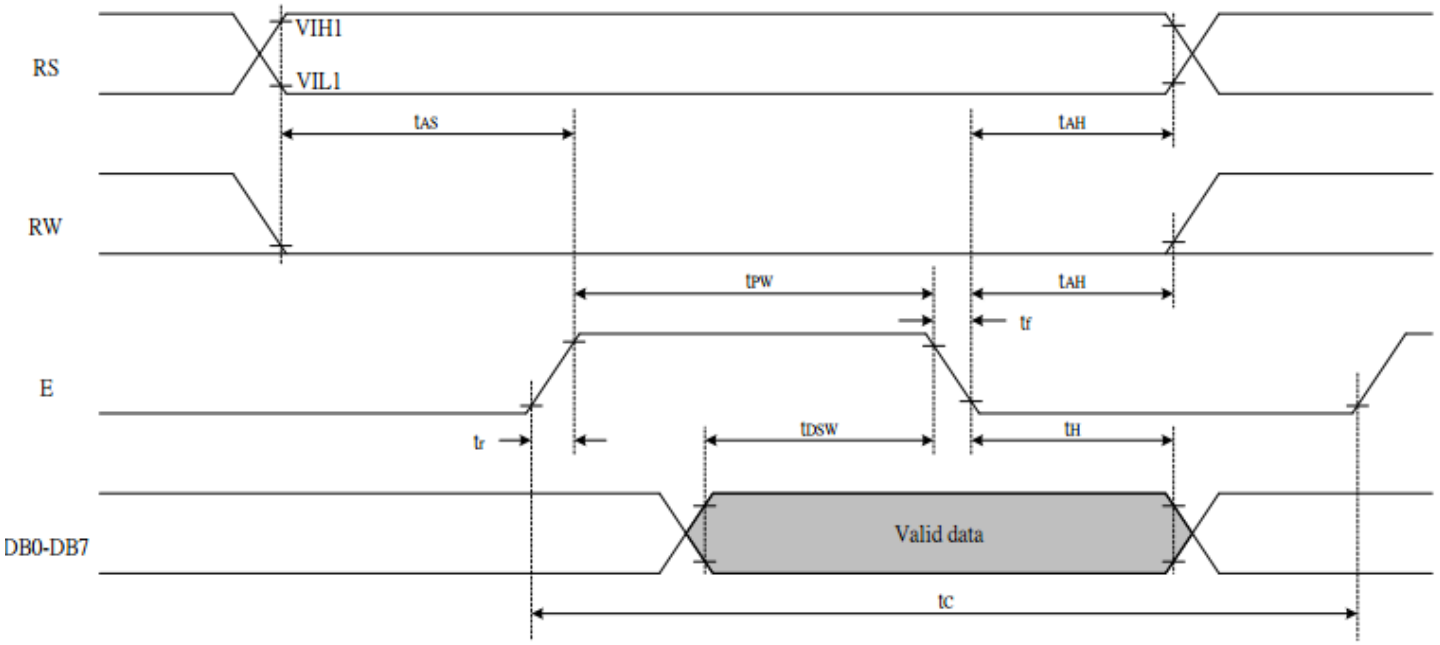
Item		Symbol	Condition	Min.	Typ.	Max.	Unit
Optimal Viewing Angles	Top	φY+	CR ≥ 2	30	40	-	º
	Bottom	φY-		50	60	-	º
	Left	θX-		50	60	-	º
	Right	θX+		50	60	-	º
Contrast Ratio		CR	-	2	5	-	-
Response Time	Rise	T_R	T_{OP} = 25°C	-	150	250	ms
	Fall	T_F		-	200	300	ms

Table of Commands

Instruction	Instruction code										Description	Execution time (fosc= 270 KHZ
	RS	R/W	DB7	DB6	DB5	DB4	DB3	DB2	DB1	DB0		
Clear Display	0	0	0	0	0	0	0	0	0	1	Write “20H” to DDRAM and set DDRAM address to “00H” from AC	1.52ms
Return Home	0	0	0	0	0	0	0	0	1	-	Set DDRAM Address to “00H” from AC and return cursor to its original position if shifted. The contents of DDRAM are not changed.	1.52ms
Entry mode Set	0	0	0	0	0	0	0	1	I/D	SH	Sets cursor move direction and specifies display shift. These parameters are performed during data write and read.	37µs
Display ON/ OFF control	0	0	0	0	0	0	1	D	C	B	D=1: Entire display on C=1: Cursor on B=1: Blinking cursor on	37µs
Cursor or Display shift	0	0	0	0	0	1	S/C	R/L	-	-	Sets cursor moving and display shift control bit, and the direction without changing DDRAM data.	37µs
Function set	0	0	0	0	1	DL	N	F	-	-	DL: Interface data is 8/4 bits N: Number of lines is 2/1 F: Font size is 5x11/5x8	37µs
Set CGRAM Address	0	0	0	1	AC5	AC4	AC3	AC2	AC1	AC0	Set CGRAM address in address counter	37µs
Set DDRAM Address	0	0	1	AC6	AC5	AC4	AC3	AC2	AC1	AC0	Set DDRAM address in address counter.	37µs
Read busy Flag and Address	0	1	BF	AC6	AC5	AC4	AC3	AC2	AC1	AC0	Whether during internal operation or not can be known by reading BF. The contents of address counter can also be read.	0s
Write data To Address	1	0	D7	D6	D5	D4	D3	D2	D1	D0	Write data into internal RAM (DDRAM/CGRAM).	37µs
Read data From RAM	1	1	D7	D6	D5	D4	D3	D2	D1	D0	Read data from internal RAM (DDRAM/CGRAM).	37µs

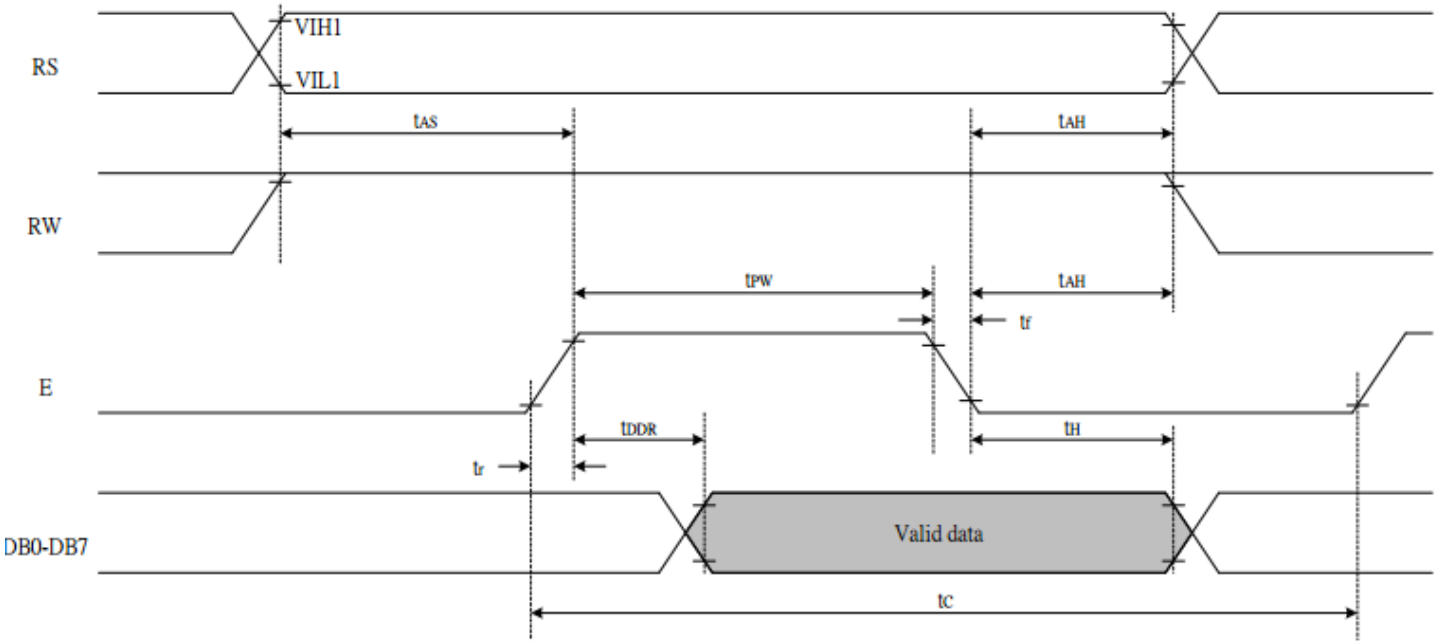
Timing Characteristics

Writing data from MPU to ST7066U



Write Mode (Writing data from MPU to ST7066U)						
T_C	Enable Cycle Time	Pin E	1200	-	-	ns
T_{PW}	Enable Pulse Width	Pin E	140	-	-	ns
T_R, T_F	Enable Rise/Fall Time	Pin E	-	-	25	ns
T_{AS}	Address Setup Time	Pins: RS,RW,E	0	-	-	ns
T_{AH}	Address Hold Time	Pins: RS,RW,E	10	-	-	ns
T_{DSW}	Data Setup Time	Pins: DB0 - DB7	40	-	-	ns
T_H	Data Hold Time	Pins: DB0 - DB7	10	-	-	ns

Reading data from ST7066U to MPU



Read Mode (Reading Data from ST7066U to MPU)						
T_C	Enable Cycle Time	Pin E	1200	-	-	ns
T_{PW}	Enable Pulse Width	Pin E	140	-	-	ns
T_R, T_F	Enable Rise/Fall Time	Pin E	-	-	25	ns
T_{AS}	Address Setup Time	Pins: RS,RW,E	0	-	-	ns
T_{AH}	Address Hold Time	Pins: RS,RW,E	10	-	-	ns
T_{DDR}	Data Setup Time	Pins: DB0 - DB7	-	-	100	ns
T_H	Data Hold Time	Pins: DB0 - DB7	10	-	-	ns

Built-in Font Table

b7-b4 / b3-b0	0000	0001	0010	0011	0100	0101	0110	0111	1000	1001	1010	1011	1100	1101	1110	1111
0000	CG RAM (1)															
0001	(2)															
0010	(3)															
0011	(4)															
0100	(5)															
0101	(6)															
0110	(7)															
0111	(8)															
1000	(1)															
1001	(2)															
1010	(3)															
1011	(4)															
1100	(5)															
1101	(6)															
1110	(7)															
1111	(8)															

Example Initialization Program

8-bit Initialization:

```
/*************************************************************/
void command(char i)
{
    P1 = i;                 //put data on output Port
    D_I =0;                 //D/I=LOW : send instruction
    R_W =0;                 //R/W=LOW : Write
    E  = 1;
    Delay(1);               //enable pulse width  >= 300ns
      E  = 0;               //Clock enable: falling edge
}
/*************************************************************/
void write(char i)
{
    P1 = i;                 //put data on output Port
    D_I =1;                 //D/I=HIGH : send data
    R_W =0;                 //R/W=LOW : Write
    E  = 1;
    Delay(1);               //enable pulse width  >= 300ns
    E  = 0;                 //Clock enable: falling edge
}
/*************************************************************/
void init()
{
    E = 0;
    Delay(100);                 //Wait >40 msec after power is applied
    command(0x30);              //command 0x30 = Wake up
    Delay(30);                  //must wait 5ms, busy flag not available
    command(0x30);              //command 0x30 = Wake up #2
    Delay(10);                  //must wait 160us, busy flag not available
    command(0x30);              //command 0x30 = Wake up #3
    Delay(10);                  //must wait 160us, busy flag not available
    command(0x38);              //Function set: 8-bit/2-line
    command(0x10);              //Set cursor
    command(0x0c);              //Display ON; Cursor ON
    command(0x06);              //Entry mode set
}
/*************************************************************/
```

4-bit Initialization:

```
/*************************************************************/
void command(char i)
{
    P1 = i;             //put data on output Port
    D_I =0;             //D/I=LOW : send instruction
    R_W =0;             //R/W=LOW : Write
    Nybble();           //Send lower 4 bits
    i = i<<4;           //Shift over by 4 bits
    P1 = i;             //put data on output Port
    Nybble();           //Send upper 4 bits
}
/*************************************************************/
void write(char i)
{
    P1 = i;             //put data on output Port
    D_I =1;             //D/I=HIGH : send data
    R_W =0;             //R/W=LOW : Write
    Nybble();           //Clock lower 4 bits
    i = i<<4;           //Shift over by 4 bits
    P1 = i;             //put data on output Port
    Nybble();           //Clock upper 4 bits
}
/*************************************************************/
void Nybble()
{
    E = 1;
    Delay(1);           //enable pulse width  >= 300ns
    E = 0;              //Clock enable: falling edge
}
/*************************************************************/
void init()
{
    P1 = 0;
    P3 = 0;
    Delay(100);             //Wait >40 msec after power is applied
    P1 = 0x30;              //put 0x30 on the output port
    Delay(30);              //must wait 5ms, busy flag not available
    Nybble();               //command 0x30 = Wake up
    Delay(10);              //must wait 160us, busy flag not available
    Nybble();               //command 0x30 = Wake up #2
    Delay(10);              //must wait 160us, busy flag not available
    Nybble();               //command 0x30 = Wake up #3
    Delay(10);              //can check busy flag now instead of delay
    P1= 0x20;               //put 0x20 on the output port
    Nybble();               //Function set: 4-bit interface
    command(0x28);          //Function set: 4-bit/2-line
    command(0x10);          //Set cursor
    command(0x0F);          //Display ON; Blinking cursor
    command(0x06);          //Entry Mode set
}
/*************************************************************/
```

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 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.

Unikeyic Electronics

Global Electronic Components Distributor

Click to view pricing, inventory, delivery, and lifecycle information:

Newhaven Display:

NHD-C0216CZ-NSW-BBW-3V3 NHD-FFC20-1 NHD-0220DZ-FSW-FBW NHD-2.1-480480AF-ASXP
NHD-3.12-25664UCY2 NHD-3.5-320240FT-CSXP-T NHD-3.5-320240JF-ASXP-CTP
NHD-4.3-800480FT-CSXP-CTP NHD-7.0-1024600AF-LSXP-CTP NHD-0420CW-AW3
NHD-7.0-800480EF-ASXV#-CTP NHD-C0216AZ-FSW-GBW NHD-0216CW-AB3 NHD-0216SZW-BB5
NHD-0220DZ-FL-YBW NHD-0220FZ-FSW-GBW-P-33V3 NHD-0224AZ-FSW-GBW
NHD-4.3-800480EZ-ASXP-CTP NHD-2.4-240320CF-CTXI#-FT NHD-7.0-HDMI-N-RSXV-CTU
NHD-7.0-800480AF-ASXP-CTP NHD-7.0-800480AF-ASXP-T NHD-2.23-12832UCY3 M0216MD-162MDBR2-J
NHD-0420AZ-FL-YBW-33V3 NHD-0420CW-AB3 NHD-2.4-240320CF-CSXV#-F NHD-5.5-25664UCG3
NHD-7.0-800480AF-LSXP-CTP NHD-7.0-800480AF-LSXP-T