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# NHD-0224WH-ATDI-JT#

## Character Liquid Crystal Display Module

NHD- Newhaven Display  
0224- 2 lines x 24 characters  
WH- Display Type: Character  
A- Model  
T- White LED Backlight  
D- FSTN- Negative (double film)  
I- Transmissive, Wide Temp. 6:00 view  
JT#- English and Japanese standard font  
**RoHS Compliant**

**Newhaven Display International, Inc.**

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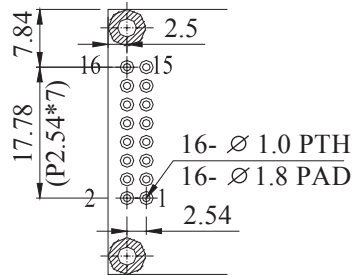
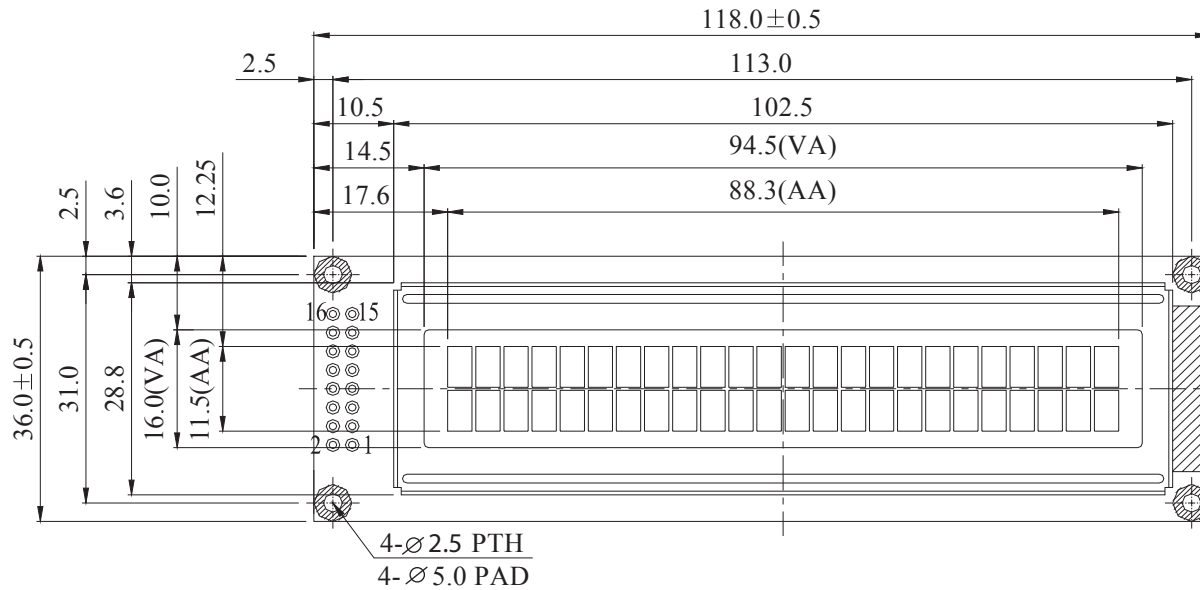
## Document Revision History

Revision	Date	Description	Changed by
0	7/24/2009	Initial Release	-
1	7/27/2009	User Guide Reformat	BE
2	11/2/2009	Block Diagram Revision	BE
3	5/20/2011	Controller information updated	AK
4	6/8/2011	Mechanical drawing updated	BE

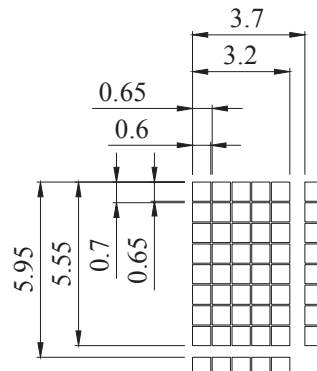
## Functions and Features

- 2 lines x 24 characters
- Built-in controller (ST7066U)
- +5.0V power supply
- 1/16 duty, 1/5 bias

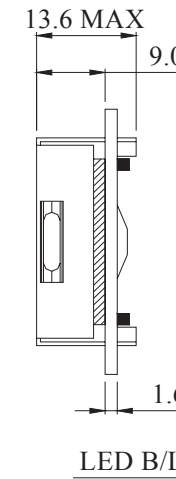
# Mechanical Drawing



PIN DETAIL  
SCALE 1/1



DOT SIZE  
SCALE 5/1



PIN NO.	SYMBOL
1	V <sub>ss</sub>
2	V <sub>dd</sub>
3	V <sub>o</sub>
4	RS
5	R/W
6	E
7	DB0
8	DB1
9	DB2
10	DB3
11	DB4
12	DB5
13	DB6
14	DB7
15	LED+
16	LED-

Newhaven Display  
NHD-0224WH-ATDI-JT#

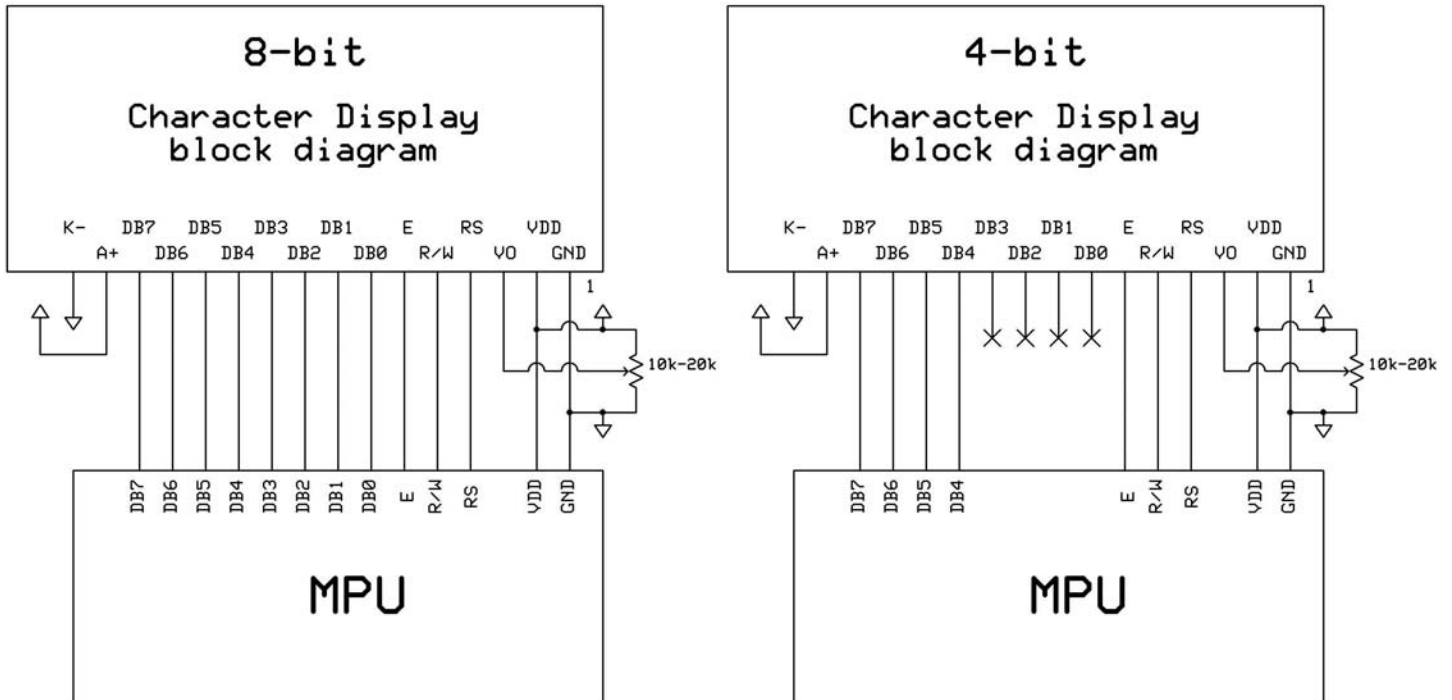
## Pin Description and Wiring Diagram

Pin No.	Symbol	External Connection	Function Description
1	$V_{SS}$	Power Supply	Ground
2	$V_{DD}$	Power Supply	Supply Voltage for logic (5.0V)
3	$V_0$	Adj Power Supply	Power supply for contrast (approx. 0.5V)
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	Power supply for LED Backlight (+3.5V)
16	LED-	Power Supply	Ground for Backlight

**Recommended LCD connector:** 2.54mm pitch, 16-pin dual-row

**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		4.5	5.0	5.5	V
Supply Current	IDD	VDD=5.0V	1.0	1.2	1.5	mA
Supply for LCD (contrast)	VDD-V0	Ta=25°C	3.8	4.5	5.5	V
"H" Level input	Vih		0.7	-	VDD	V
"L" Level input	Vil		Vss	-	0.6	V
"H" Level output	Voh		3.9	-	-	V
"L" Level output	Vol		-	-	0.4	V
Backlight Supply Voltage	Vled	-	3.4	3.5	3.6	V
Backlight Supply Current	Iled	Vled=3.5V	28.8	32	50	mA
Backlight Lifetime		Iled=32	-	50,000	-	Hrs

## Optical Characteristics

Item	Symbol	Condition	Min.	Typ.	Max.	Unit
Viewing Angle – Vertical (top)	AV	Cr ≥ 2	-	25	-	°
Viewing Angle – Vertical (bottom)	AV	Cr ≥ 2	-	70	-	°
Viewing Angle – Horizontal (left)	AH	Cr ≥ 2	-	30	-	°
Viewing Angle – Horizontal (right)	AH	Cr ≥ 2	-	30	-	°
Contrast Ratio	Cr		-	2	-	-
Response Time (rise)	Tr	-	-	120	150	ms
Response Time (fall)	Tf	-	-	120	150	ms

## Controller Information

Built-in ST7066U. Download specification at [http://www.newhavendisplay.com/app\\_notes/ST7066U.pdf](http://www.newhavendisplay.com/app_notes/ST7066U.pdf)

## Display Character Address Code

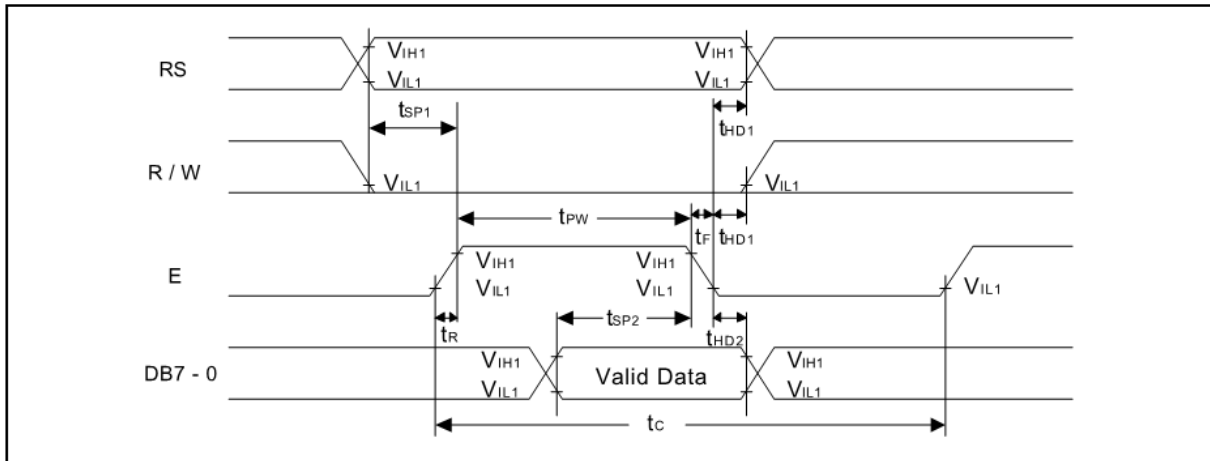
Character located	1	2	3	4	5	6	-----	19	20	21	22	23	24
DDRAM address	00	01	02	03	04	05	-----	12	13	14	15	16	17
DDRAM address	40	41	42	43	44	45	-----	52	53	54	55	56	57

## Table of Commands

Instruction	Instruction Code										Description	Execution time (fosc=270Khz)	
	RS	R/W	DB7	DB6	DB5	DB4	DB3	DB2	DB1	DB0			
Clear Display	0	0	0	0	0	0	0	0	0	1	Write "00H" to DDRAM and set DDRAM address to "00H" from AC	1.53ms	
Return Home	0	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.	1.53ms	
Entry Mode Set	0	0	0	0	0	0	0	0	1	I/D	SH	Assign cursor moving direction and enable the shift of entire display.	39 $\mu$ s
Display ON/OFF Control	0	0	0	0	0	0	0	1	D	C	B	Set display (D), cursor (C), and blinking of cursor (B) on/off control bit.	39 $\mu$ s
Cursor or Display Shift	0	0	0	0	0	0	1	S/C	R/L	—	—	Set cursor moving and display shift control bit, and the direction, without changing of DDRAM data.	39 $\mu$ s
Function Set	0	0	0	0	0	1	DL	N	F	—	—	Set interface data length (DL:8-bit/4-bit), numbers of display line (N:2-line/1-line)and, display font type (F:5x11 dots/5x8 dots)	39 $\mu$ s
Set CGRAM Address	0	0	0	1	AC5	AC4	AC3	AC2	AC1	AC0		Set CGRAM address in address counter.	39 $\mu$ s
Set DDRAM Address	0	0	1	AC6	AC5	AC4	AC3	AC2	AC1	AC0		Set DDRAM address in address counter.	39 $\mu$ s
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.	0 $\mu$ s
Write Data to RAM	1	0	D7	D6	D5	D4	D3	D2	D1	D0		Write data into internal RAM (DDRAM/CGRAM).	43 $\mu$ s
Read Data from RAM	1	1	D7	D6	D5	D4	D3	D2	D1	D0		Read data from internal RAM (DDRAM/CGRAM).	43 $\mu$ s

# Timing Characteristics

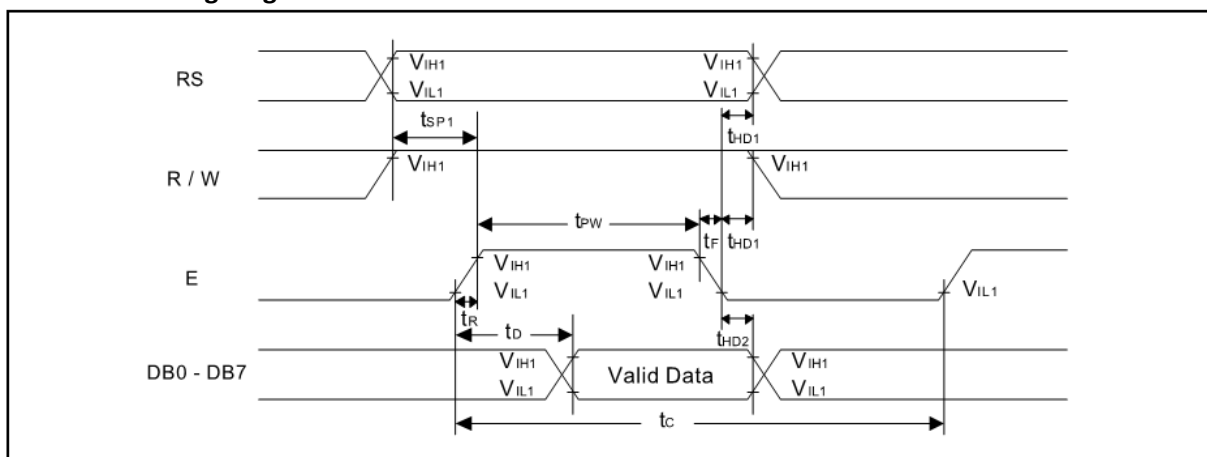
Read mode timing diagram



$T_a=25^\circ\text{C}$ ,  $V_{DD}=5.0\text{V}$

Item	Symbol	Min	Typ	Max	Unit
Enable cycle time	$T_C$	1200	—	—	ns
Enable pulse width	$T_{PW}$	140	—	—	ns
Enable rise/fall time	$T_R, T_F$	—	—	25	ns
Address set-up time (RS, R/W to E)	$t_{AS}$	0	—	—	ns
Address hold time	$t_{AH}$	10	—	—	ns
Data set-up time	$t_{DSW}$	40	—	—	ns
Data hold time	$t_H$	10	—	—	ns

Read mode timing diagram





# Built-in Font Table

Upper 4 bit Lower 4 bit	LLLL	LLLH	LLHL	LLHH	LHLL	LHLH	LHHL	LHHH	HLLL	HLLH	HLHL	HLHH	HHLL	HHLH	HHHL	HHHH
LLLL	CG RAM (1)			0	1	2	3	4			5	6	7	8	9	A
LLLH	(2)	!	"	#	\$	%	&	'	(	)	*	+	,	-	.	/
LLHL	(3)	:	;	<	=	>	?	@	[	]	^	_	~			
LLHH	(4)															
LHLL	(5)															
LHLH	(6)															
LHHL	(7)															
LHHH	(8)															
HLLL	(1)															
HLLH	(2)															
HLHL	(3)															
HLHH	(4)															
HHLL	(5)															
HHLH	(6)															
HHHL	(7)															
HHHH	(8)															

## Example Initialization Program

### 4-bit:

```
void command(char i)
{
    P1 = i;
    D_I =0;           //Send Instruction
    R_W =0;
    Nybble();
    i = i<<4;
    P1 = i;
    Nybble();
}
void write(char i)
{
    P1 = i;
    D_I =1;           //Send Data
    R_W =0;
    Nybble();
    i = i<<4;
    P1 = i;
    Nybble();
}
void Nybble()
{
    E = 1;
    Delays(10);      //enable pulse width >= 300ns
    E = 0;
}

void init()
{
    P1 = 0;
    P3 = 0;
    Delays(30);
    P1 = 0x30;        //Wake up
    Delays(100);
    Nybble();
    Delays(100);
    Nybble();
    Delays(10);
    Nybble();        //Wake up three times
    Delays(10);
    P1= 0x20;        //Function set: 4-bit
    Nybble();
    command(0x28);   //Function set: 4-bit/2-line
    command(0x10);   //Set cursor
    command(0x0F);   //Display ON; Blinking cursor
    command(0x06);   //Entry Mode set
}
```

### 8-bit:

```
void command(char i)
{
    P1 = i;
    D_I = 0;           //Send Instruction
    R_W = 0;
    E = 1;
    Delays(1);
    E = 0;
}

void write(char i)
{
    P1 = i;
    D_I = 1;           //Send Data
    R_W = 0;
    E = 1;
    Delays(1);
    E = 0;
}

void init()
{
    E = 0;
    Delays(5);
    command(0x30);     //Wake up
    Delays(100);
    command(0x30);
    Delays(10);
    command(0x30);     //Wake up three times
    Delays(10);
    command(0x38);     //Function set: 8-bit/2-line
    command(0x10);     //Set cursor
    command(0x0c);     //Display ON; Cursor ON
    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 , 200hrs	2
Low Temperature storage	Endurance test applying the low storage temperature for a long time.	-30°C , 200hrs	1,2
High Temperature Operation	Endurance test applying the electric stress (voltage & current) and the high thermal stress for a long time.	+70°C 200hrs	2
Low Temperature Operation	Endurance test applying the electric stress (voltage & current) and the low thermal stress for a long time.	-20°C , 200hrs	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.	-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.

## 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)