

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

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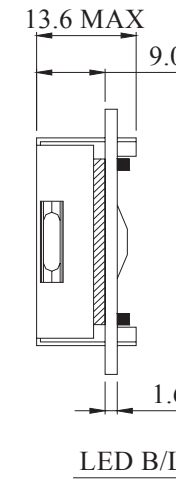
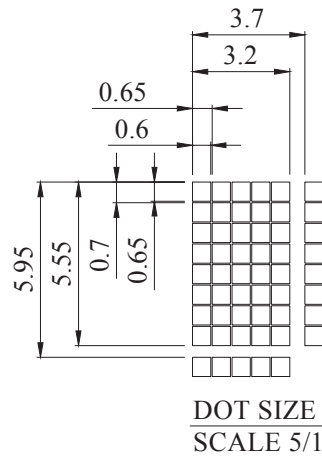
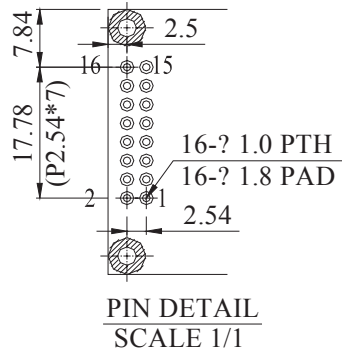
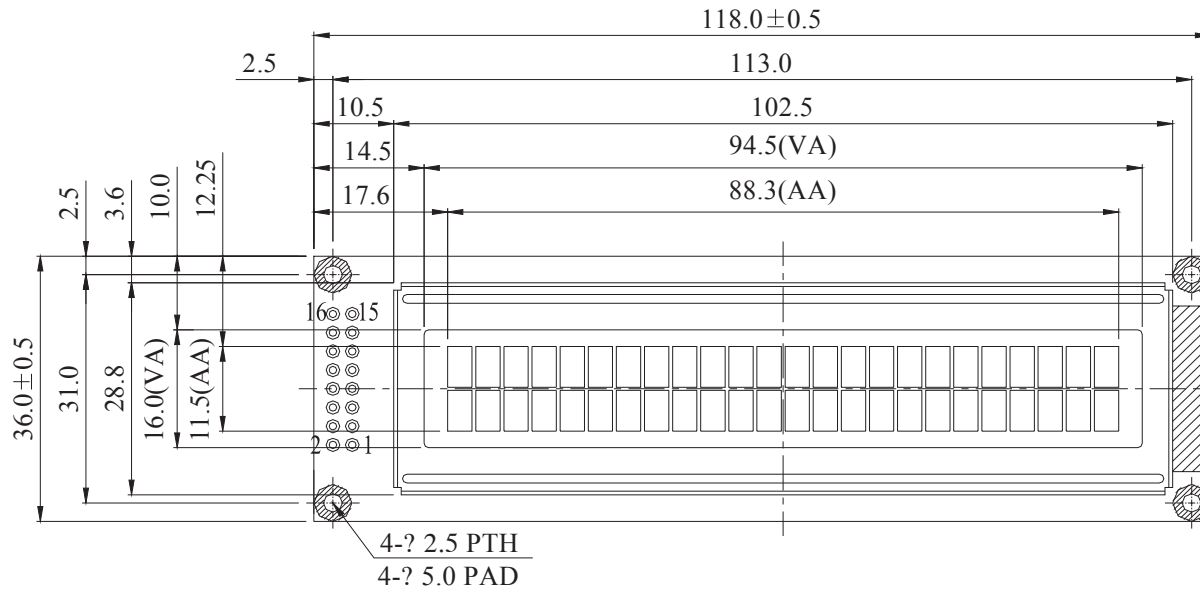
Document Revision History

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

Functions and Features

- 2 lines x 24 characters
- Built-in controller (SPLC780D or equivalent)
- +5.0V power supply
- 1/16 duty, 1/5 bias

Mechanical Drawing



PIN NO.	SYMBOL
1	V _{ss}
2	V _{dd}
3	V _o
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
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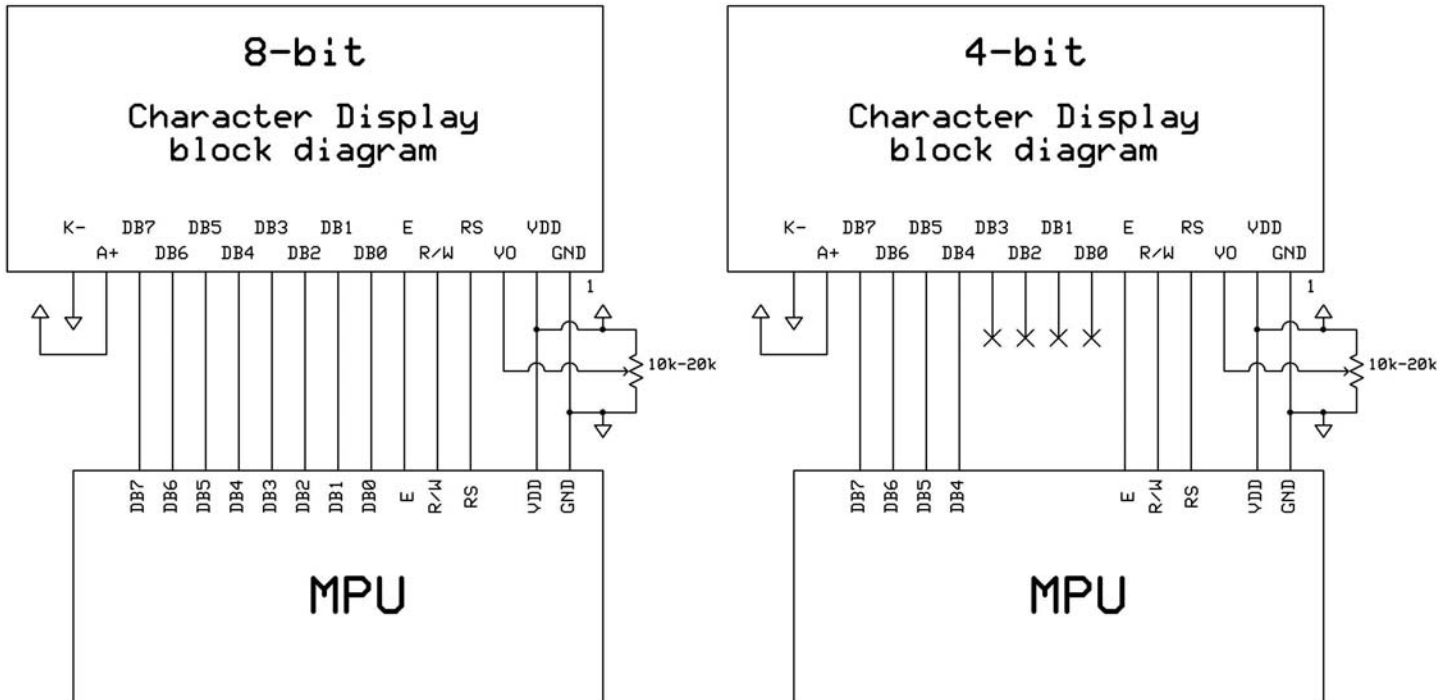
Pin Description and Wiring Diagram

Pin No.	Symbol	External Connection	Function Description
1	V_{SS}	Power Supply	Ground
2	V_{DD}	Power Supply	Supply Voltage for logic (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 SPLC780D. Download specification at http://www.newhavendisplay.com/app_notes/SPLC780D.pdf

Table of Commands

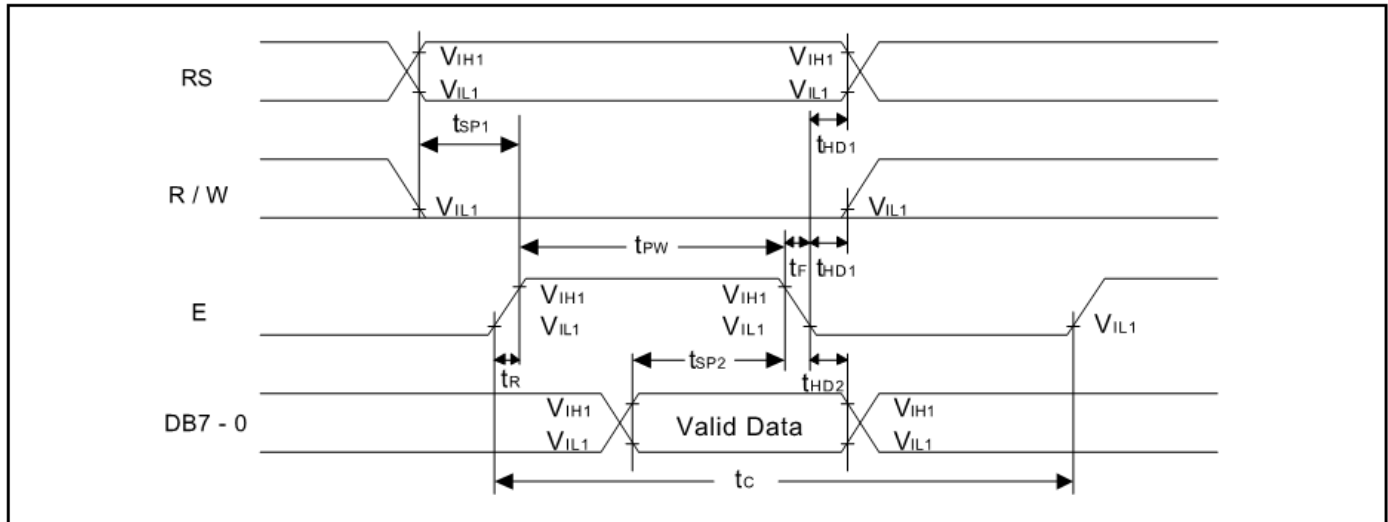
Instruction	Instruction Code										Description	Execution time (fosc=270Khz)
	RS	R/W	DB7	DB6	DB5	DB4	DB3	DB2	DB1	DB0		
Clear Display	0	0	0	0	0	0	0	0	0	1	Write "00H" to DDRAM and set DDRAM address to "00H" from AC	1.53ms
Return Home	0	0	0	0	0	0	0	0	1	—	Set DDRAM address to "00H" from AC and return cursor 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	1	I/D	SH	Assign cursor moving direction and enable the shift of entire display.	39 μ s
Display ON/OFF Control	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 μ s
Cursor or Display Shift	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 μ s
Function Set	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 μ s
Set CGRAM Address	0	0	0	1	AC5	AC4	AC3	AC2	AC1	AC0	Set CGRAM address in address counter.	39 μ s
Set DDRAM Address	0	0	1	AC6	AC5	AC4	AC3	AC2	AC1	AC0	Set DDRAM address in address counter.	39 μ 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 μ s
Write Data to RAM	1	0	D7	D6	D5	D4	D3	D2	D1	D0	Write data into internal RAM (DDRAM/CGRAM).	43 μ s
Read Data from RAM	1	1	D7	D6	D5	D4	D3	D2	D1	D0	Read data from internal RAM (DDRAM/CGRAM).	43 μ s

* "—" : don't care

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

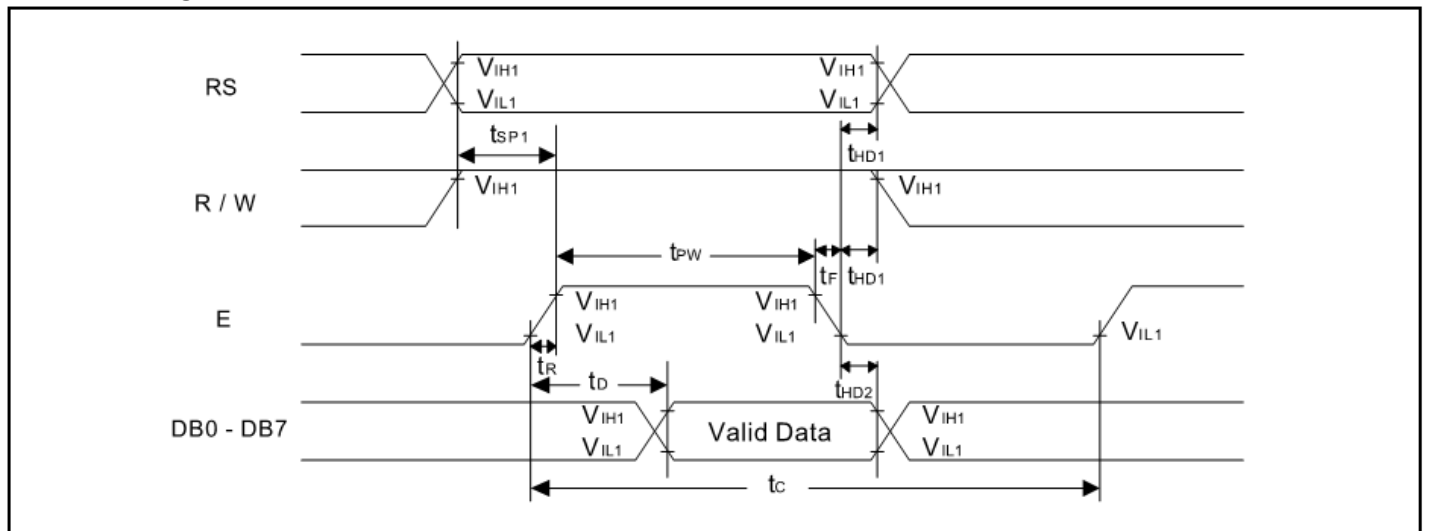
Write mode timing diagram



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

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

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;
    Delayms(1);
    E = 0;
}

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

void init()
{
    E = 0;
    Delayms(5);
    command(0x30);   //Wake up
    Delayms(100);
    command(0x30);
    Delayms(10);
    command(0x30);   //Wake up three times
    Delayms(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

Warranty Information and Terms & Conditions

http://www.newhavendisplay.com/index.php?main_page=terms