NHD-0208AZ-RN-YBW

Character Liquid Crystal Display Module

NHD-	Newhaven Display
0208-	2 Lines x 8 Characters
AZ-	Model
R-	Reflective
N-	No Backlight
Y-	STN- Yellow/Green
B-	6:00 Optimal View
W-	Wide Temperature
	RoHS Compliant

Document Revision History

Revision	Date	Description	Changed by
0	9/19/2007	Initial Release	-
1	10/5/2009	User Guide Reformat	BE
2	10/19/2009	Block Diagram, Mechanical Drawing Revision	BE
3	12/29/2009	Optical revised	BE
4	1/5/2011	Alternate controller information updated	AK
5	2/7/2011	Mechanical drawing updated	AK
6	4/19/2011	Electrical characteristics updated	AK
7	8/26/2011	Mechanical drawing updated	AK
8	4/24/2014	Mechanical drawing updated	ML
9	5/9/2014	Electrical characteristics, Optical characteristics updated	ML

Functions and Features

- **2 lines x 8 characters**
- **Built-in controller (ST7066U)**
- **+5.0V Power Supply**
- **1/16 duty, 1/5 bias**
- **RoHS compliant**

Mechanical Drawing
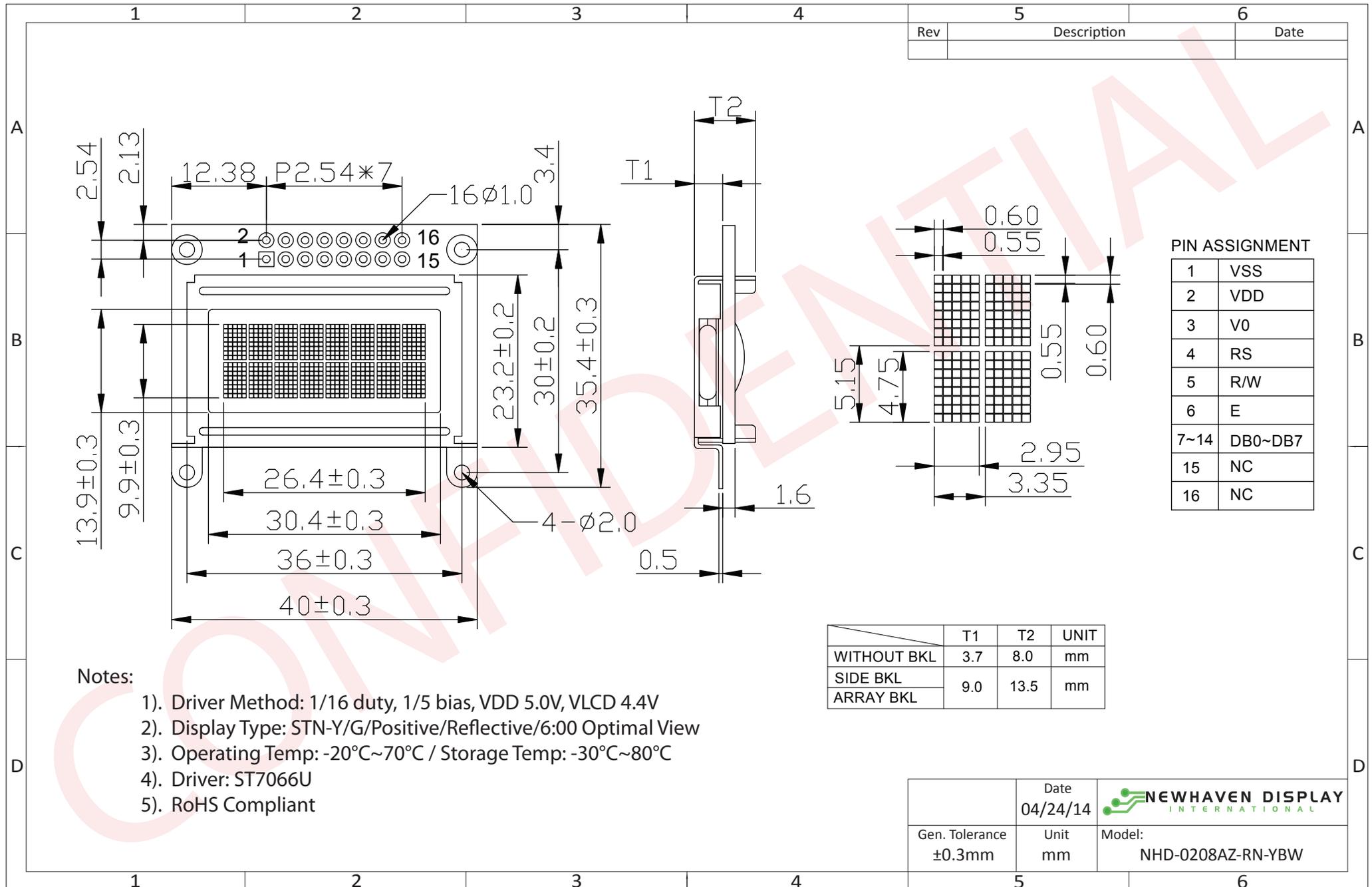
	Rev	Description	Date

PIN ASSIGNMENT

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

	T1	T2	UNIT
WITHOUT BKL	3.7	8.0	mm
SIDE BKL	9.0	13.5	mm
ARRAY BKL			

Notes:
1). Driver Method: 1/16 duty, 1/5 bias, VDD 5.0V, VLCD 4.4V
2). Display Type: STN-Y/G/Positive/Reflective/6:00 Optimal View
3). Operating Temp: -20°C~70°C / Storage Temp: -30°C~80°C
4). Driver: ST7066U
5). RoHS Compliant

	Date	NEWHAVEN DISPLAY
	04/24/14	INTERNATIONAL
Gen. Tolerance	Unit	Model:
±0.3mm	mm	NHD-0208AZ-RN-YBW

Pin Description and Wiring Diagram

Pin No.	Symbol	External Connection	Function Description
1	VSS	Power Supply	Ground
2	VDD	Power Supply	Supply Voltage for logic (+5.0V)
3	V0	Adj Power Supply	Power supply for contrast (approx. +0.6V)
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	NC	-	No Connect
16	NC	-	No Connect

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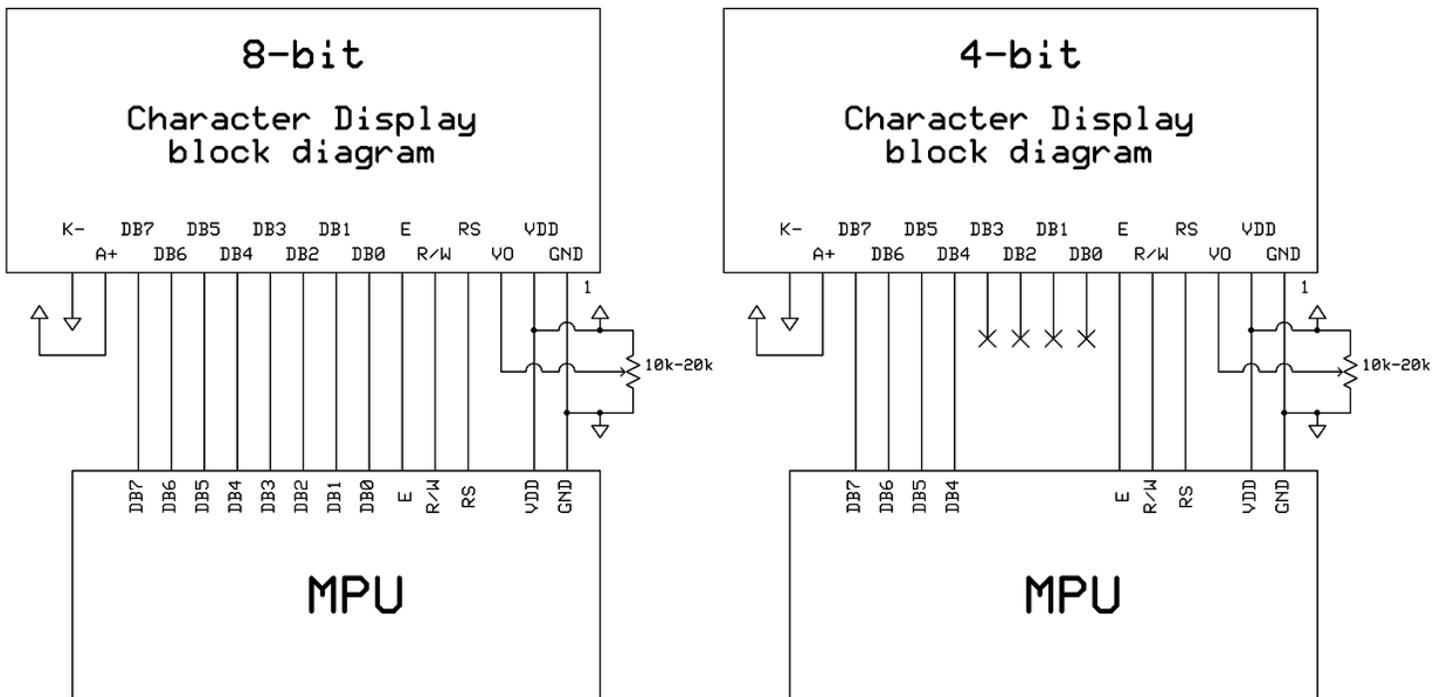
Electrical Characteristics

Item	Symbol	Condition	Min.	Typ.	Max.	Unit
Operating Temperature Range	Top	Absolute Max	-20	-	+70	⁰C
Storage Temperature Range	Tst	Absolute Max	-30	-	+80	⁰C
Supply Voltage	VDD		4.8	5.0	5.2	V
Supply Current	IDD	Ta=25°C, VDD=5.0V	-	1.5	2.0	mA
Supply for LCD (contrast)	VDD-V0	Ta=25°C	4.2	4.4	4.6	V
"H" Level input	Vih		0.7*VDD	-	VDD	V
"L" Level input	Vil		-0.3	-	0.6	V
"H" Level output	Voh		3.9	-	VDD	V
"L" Level output	Vol		GND	-	0.4	V

Optical Characteristics

Item	Symbol	Condition	Min.	Typ.	Max.	Unit
Viewing Angle – Top			-	40	-	º
Viewing Angle – Bottom		Cr ≥ 2	-	60	-	º
Viewing Angle – Left			-	60	-	º
Viewing Angle – Right			-	60	-	º
Contrast Ratio	Cr	-	2	5	-	-
Response Time (rise)	Tr	-	-	150	250	ms
Response Time (fall)	Tf	-	-	200	300	ms

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

Table of Commands

Instruction	Instruction Code										Description	Description Time (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 "20H" to DDRAM. and set DDRAM address to "00H" from AC	1.52 ms
Return Home	0	0	0	0	0	0	0	0	1	x	Set DDRAM address to "00H" from AC and return cursor to its original position if shifted. The contents of DDRAM are not changed.	1.52 ms
Entry Mode Set	0	0	0	0	0	0	0	1	I/D	S	Sets cursor move direction and specifies display shift. These operations are performed during data write and read.	37 us
Display ON/OFF	0	0	0	0	0	0	1	D	C	B	D=1:entire display on C=1:cursor on B=1:cursor position on	37 us
Cursor or Display Shift	0	0	0	0	0	1	S/C	R/L	x	x	Set cursor moving and display shift control bit, and the direction, without changing DDRAM data.	37 us
Function Set	0	0	0	0	1	DL	N	F	x	x	DL:interface data is 8/4 bits N:number of line is 2/1 F:font size is 5x11/5x8	37 us
Set CGRAM address	0	0	0	1	AC5	AC4	AC3	AC2	AC1	AC0	Set CGRAM address in address counter	37 us
Set DDRAM address	0	0	1	AC6	AC5	AC4	AC3	AC2	AC1	AC0	Set DDRAM address in address counter	37 us
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 us
Write data to RAM	1	0	D7	D6	D5	D4	D3	D2	D1	D0	Write data into internal RAM (DDRAM/CGRAM)	37 us
Read data from RAM	1	1	D7	D6	D5	D4	D3	D2	D1	D0	Read data from internal RAM (DDRAM/CGRAM)	37 us

Timing Characteristics

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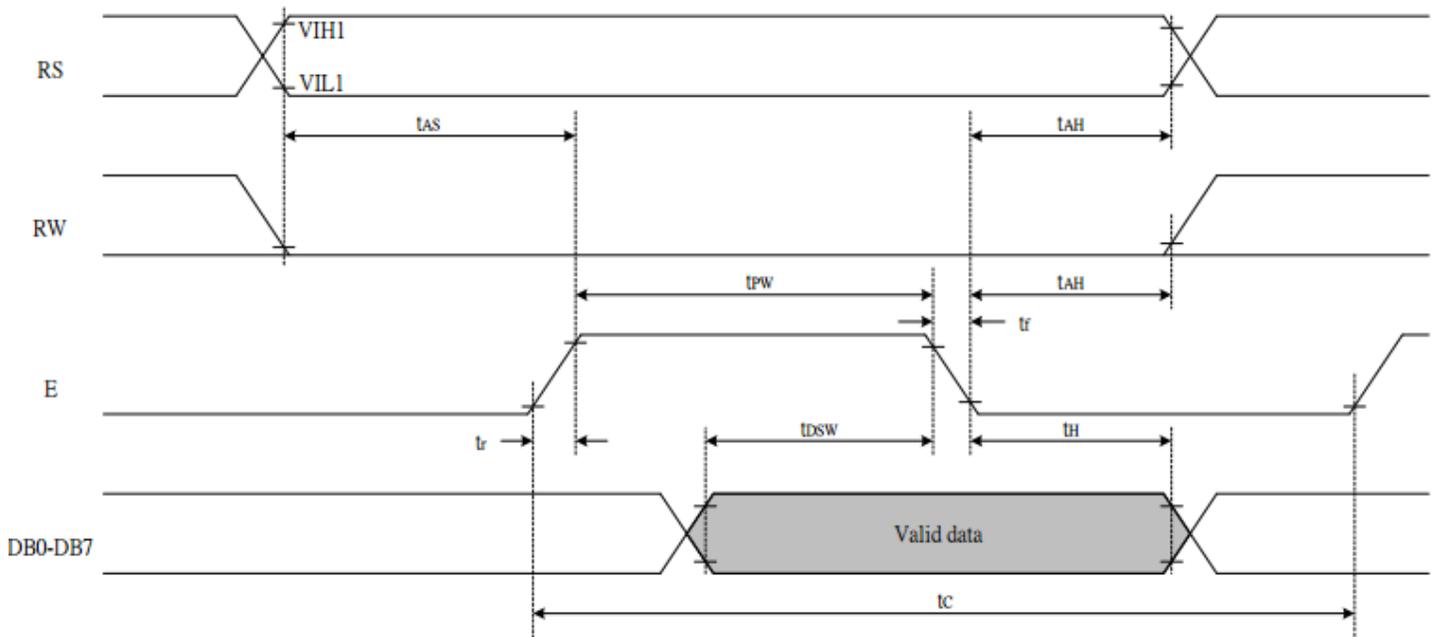
		Write Mode (Writing data from MPU to ST7066U)				
T_C	Enable Cycle Time	Pin E	1200	-	-	ns
T_{PW}	Enable Pulse Width	Pin E	140	-	-	ns
T_R, T_F	Enable Rise/Fall Time	Pin E	-	-	25	ns
T_{AS}	Address Setup Time	Pins: RS,RW,E	0	-	-	ns
T_{AH}	Address Hold Time	Pins: RS,RW,E	10	-	-	ns
T_{DSW}	Data Setup Time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

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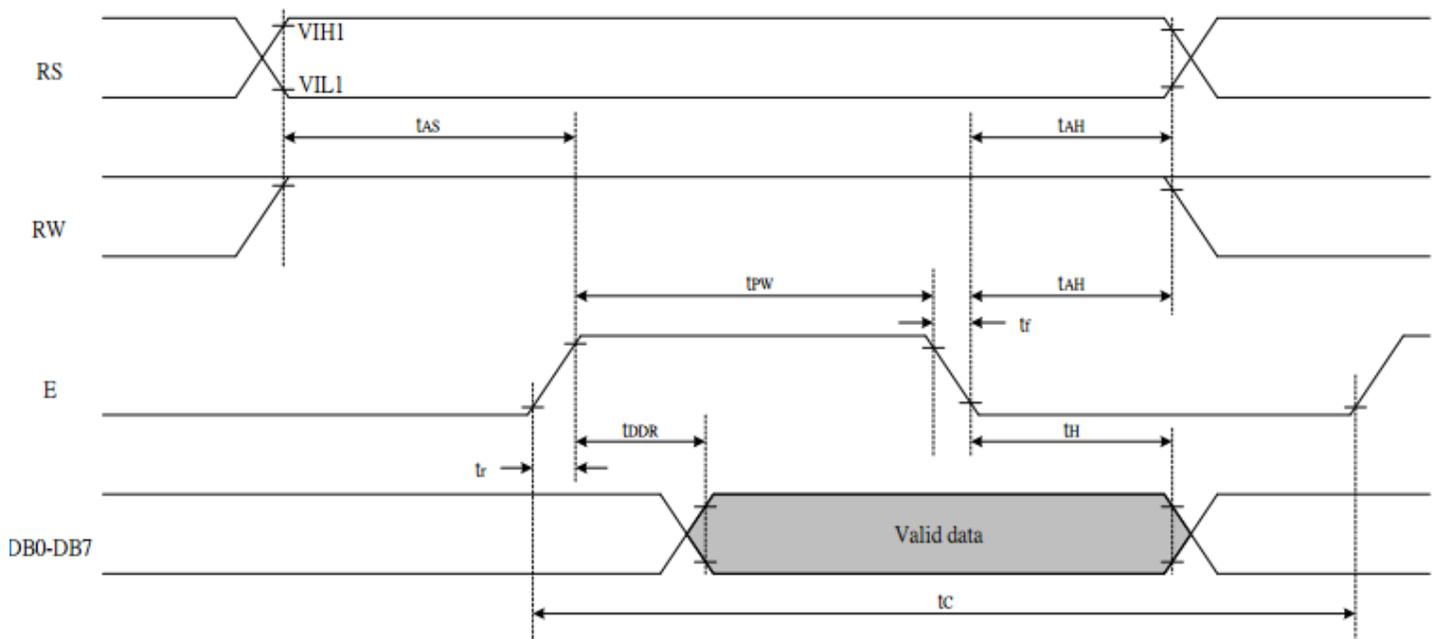
Read Mode (Reading Data from ST7066U to MPU)						
T_C	Enable Cycle Time	Pin E	1200	-	-	ns
T_{PW}	Enable Pulse Width	Pin E	140	-	-	ns
T_R,T_F	Enable Rise/Fall Time	Pin E	-	-	25	ns
T_{AS}	Address Setup Time	Pins: RS,RW,E	0	-	-	ns
T_{AH}	Address Hold Time	Pins: RS,RW,E	10	-	-	ns
T_{DDR}	Data Setup Time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

Built-in Font Table

Lower 4 Bits \ Upper 4 Bits	0000	0001	0010	0011	0100	0101	0110	0111	1000	1001	1010	1011	1100	1101	1110	1111
xxxx0000	CG RAM (1)			0	@	P	`	p				─	タ	ミ	α	p
xxxx0001	(2)		!	1	A	Q	a	q			｡	ア	チ	ム	ä	q
xxxx0010	(3)		"	2	B	R	b	r			｢	イ	ツ	メ	β	θ
xxxx0011	(4)		#	3	C	S	c	s			｣	ウ	テ	モ	ε	∞
xxxx0100	(5)		$	4	D	T	d	t			､	エ	ト	ヤ	μ	Ω
xxxx0101	(6)		%	5	E	U	e	u			・	オ	ナ	ユ	σ	ü
xxxx0110	(7)		&	6	F	V	f	v			ヲ	カ	ニ	ヨ	ρ	Σ
xxxx0111	(8)		'	7	G	W	g	w			ア	キ	ヌ	ラ	g	π
xxxx1000	(1)		(	8	H	X	h	x			ィ	ク	ネ	リ	√	x̄
xxxx1001	(2)		)	9	I	Y	i	y			ゥ	ケ	ノ	ル	ˉ¹	y
xxxx1010	(3)		*	:	J	Z	j	z			ェ	コ	ハ	レ	j	千
xxxx1011	(4)		+	;	K	[	k	{			ォ	サ	ヒ	ロ	×	万
xxxx1100	(5)		,	<	L	¥	l						ャ	シ	フ	ワ	¢	円
xxxx1101	(6)		-	=	M	]	m	}			ュ	ス	ヘ	ン	Ł	÷
xxxx1110	(7)		.	>	N	^	n	→			ョ	セ	ホ	゛	ñ	
xxxx1111	(8)		/	?	O	_	o	←			ッ	ソ	マ	゜	ö	█

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.

Precautions for using LCDs/LCMs

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

Warranty Information

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

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