

NHD-C0220AA-FSW-FTW

Graphic Liquid Crystal Display Module

NHD-	Newhaven Display
C0220-	COG, 2 Lines x 20 Characters
AA-	Model
F-	Transflective
SW-	Side White LED Backlight
F-	FSTN(+)
T-	12:00 Optimum Viewing Angle
W-	Wide Temp
	RoHS Compliant

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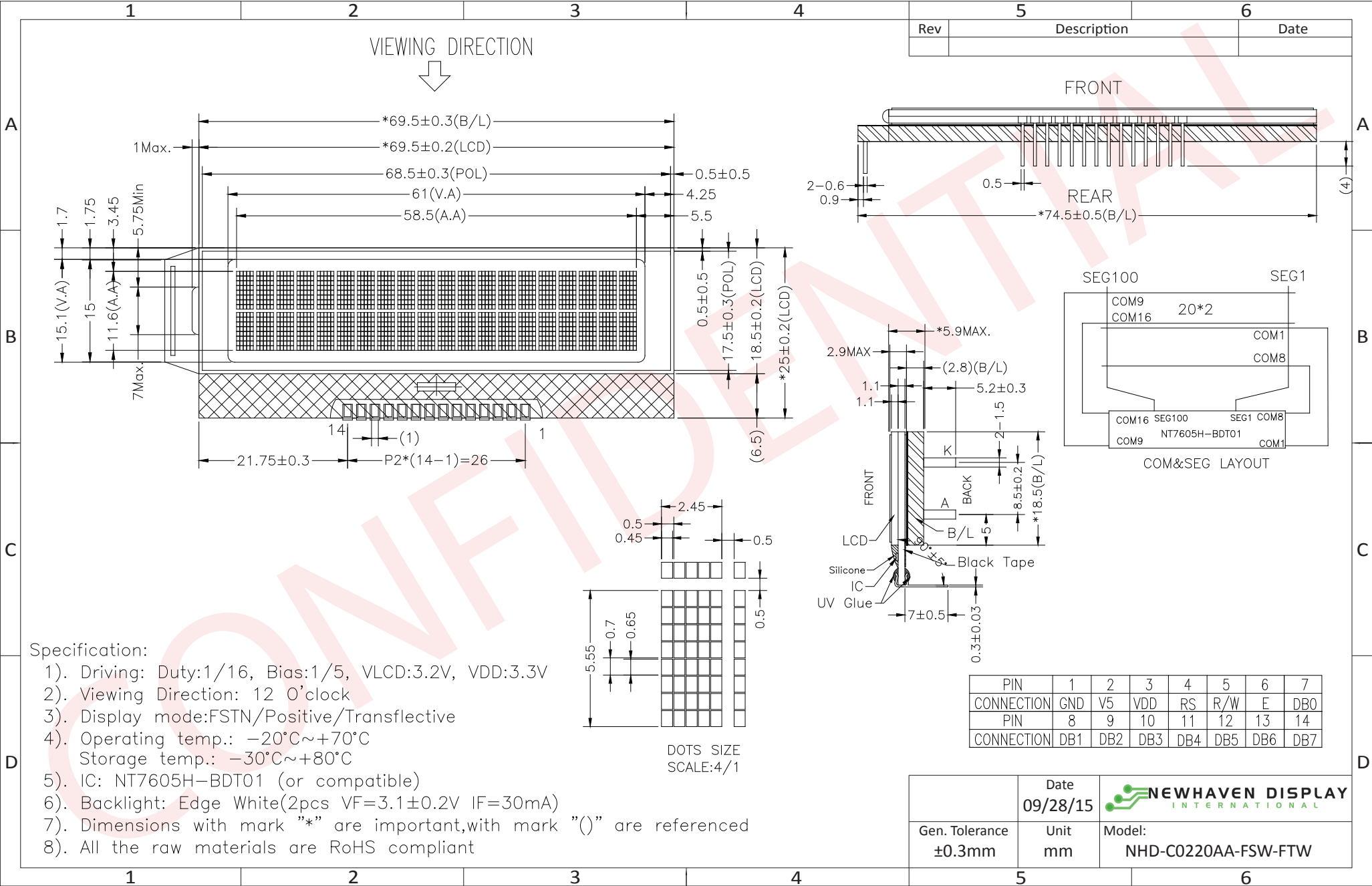
Document Revision History

Revision	Date	Description	Changed by
0	11/5/2010	Initial Release	-
1	5/27/2011	Display character address code updated	AK
2	6/2/2011	Timing characteristics updated	AK
3	9/28/2015	Electrical characteristics, response times updated, mechanical drawing reformatted	SB

Functions and Features

- 2 lines x 20 characters
- Built-in NT7605 controller
- 3.3V power supply
- 1/16 duty, 1/5 bias

Mechanical Drawing



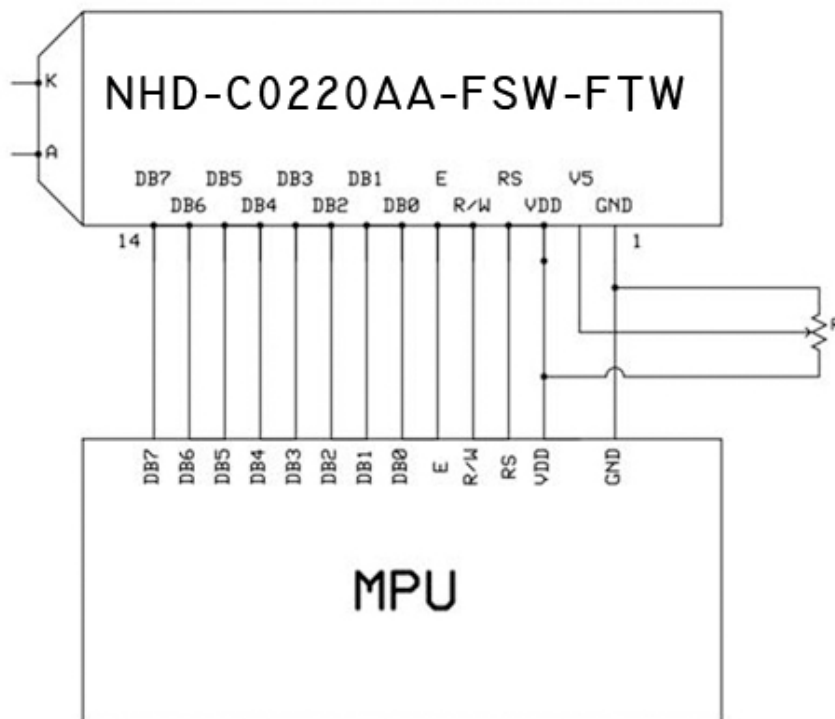
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Pin Description and Wiring Diagram

Pin No.	Symbol	External Connection	Function Description
1	GND	Power Supply	Ground
2	V5	Adj Power Supply	Supply voltage for Contrast (approx.. 0.1V)
3	VDD	Power Supply	Supply voltage for Logic (3.3V)
4	RS	MPU	Register Select: 0=Instruction, 1=Data
5	R/W	MPU	Read / Write select: 0=Write, 1=Read
6	E	MPU	Operation Enable
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.
A	LED +	Power Supply	Backlight Anode (+3.0V)
K	LED -	Power Supply	Backlight Cathode (Ground)

Recommended LCD connector: 2.0mm pitch, 14pins Soldered to PCB, or JST p/n: PHR-14

Backlight connector: A and K pins **Mates with:** Solder to wires or PCB



Electrical Characteristics

Item	Symbol	Condition	Min.	Typ.	Max.	Unit
Operating Temperature Range	Top	Absolute Max	-20	25	+70	°C
Storage Temperature Range	Tst	Absolute Max	-30	25	+80	°C
Supply Voltage	VDD		3.2	3.3	3.5	V
Supply Current	IDD	VDD=3.3V	-	-	2	mA
Supply for LCD (contrast)	Vlcd	Ta = 25°	3.1	3.2	3.3	V
"H" Level input	Vih		0.8VDD	-	VDD	V
"L" Level input	Vil		0	-	0.2VDD	V
"H" Level output	Voh		VDD-0.6	-	VDD	V
"L" Level output	Vol		GND	-	GND+0.6	V
Backlight Supply Voltage	VLED		2.9	3.0	3.2	V
Backlight Supply Current	Iled	VLED=3.1V	-	30	-	mA

Optical Characteristics

Item	Symbol	Condition	Min.	Typ.	Max.	Unit
Viewing Angle - Vertical	AV	Cr ≥ 2	-30	-	+30	°
Viewing Angle - Horizontal	AH		-20	-	+20	°
Contrast Ratio	Cr	Ta = 25°	-	4	-	
Response Time (rise)	Tr		-	100	160	ms
Response Time (fall)	Tr		-	150	200	ms

Controller Information

Built-in NT7605N-BDT01 controller.

Please download specification at http://www.newhavendisplay.com/app_notes/NT7605.pdf

NOTE: The Busy Flag of the NT7605 controller may not always be responsive. Add sufficient delays and/or a time-out check routine to continue operation if busy flag is not cleared.

Note: during internal operation, busy flag (DB7) is read "High".
 Busy flag check must be preceded by the next instruction.

DDRAM Address

1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
00	01	02	03	04	05	06	07	08	09	0A	0B	0C	0D	0E	0F	10	11	12	13
40	41	42	43	44	45	46	47	48	49	4A	4B	4C	4D	4E	4F	50	51	52	53

Table of Commands

Instruction	INSTRUCTION CODE										Description	Execution Time (Max) (fosc = 540KHZ)
	RS	R/W	DB7	DB6	DB5	DB4	DB3	DB2	DB1	DB0		
Clear Display	0	0	0	0	0	0	0	0	0	1	Clear entire display area. Restore display from shift, and load address counter with DDRAM address 00H	1.64ms
Display/ Cursor Home	0	0	0	0	0	0	0	0	1	-	Restore display from shift and load address counter with DDRAM address 00H	1.64ms
Entry mode Set	0	0	0	0	0	0	0	1	I/D	S	Specify direction of cursor movement and display shift mode. This operation takes place after each data transfer (read/write)	40μs
Display ON/ OFF control	0	0	0	0	0	0	1	D	C	B	Set activation of display (D), cursor (C), and Blinking of cursor (B)	40μs
Display/ Cursor	0	0	0	0	0	1	S/C	R/L	-	-	Shift display or move cursor	40μs
Function set	0	0	0	0	1	DL	N	F	-	-	Set interface data length (DL) number of the display line (N), and character font (F)	40μs
RAM Address Set	0	0	0	1	ACG						Set CGRAM address in address counter.	40μs
DDRAM Address Set	0	0	1	ADD							Set DDRAM address in address counter.	40μs
Busy Flag/ Address Counter Read	0	1	BF	AC							Read Busy Flag (BF) and contents of Address Counter (AC)	1μs
CGRAM/ DDRAM Data Write	1	0	Write Data								Write data into internal RAM (DDRAM/CGRAM).	40μs
CGRAM/ DDRAM Data Read	1	1	Read Data								Read data from internal RAM (DDRAM/CGRAM).	40μs
	I/D = 1 : Increment S = 1 : Display Shift On D = 1 : Display On C = 1 : Cursor Display On B = 1 : Cursor Blink On S/C = 1 : Shift Display R/L = 1 : Shift Right DL = 1 : 8-Bit N = 1 : Dual Line F = 1 : 5x10 dots BF = 1 : Internal Operation BF = 0 : Ready for Instruction I/D = 0 : Decrement S/C = 0 : Move Cursor R/L = 0 : Shift Left DL = 0 : 4-Bit N = 0 : Single Line F = 0 : 5x8 dots										DDRAM : Display Data Ram CGRAM : Character Generator RAM ACG : Character Generator RAM Address ADD : Display Data RAM Address AC : Address Counter	

Timing Characteristics

Write from MPU to NT7605

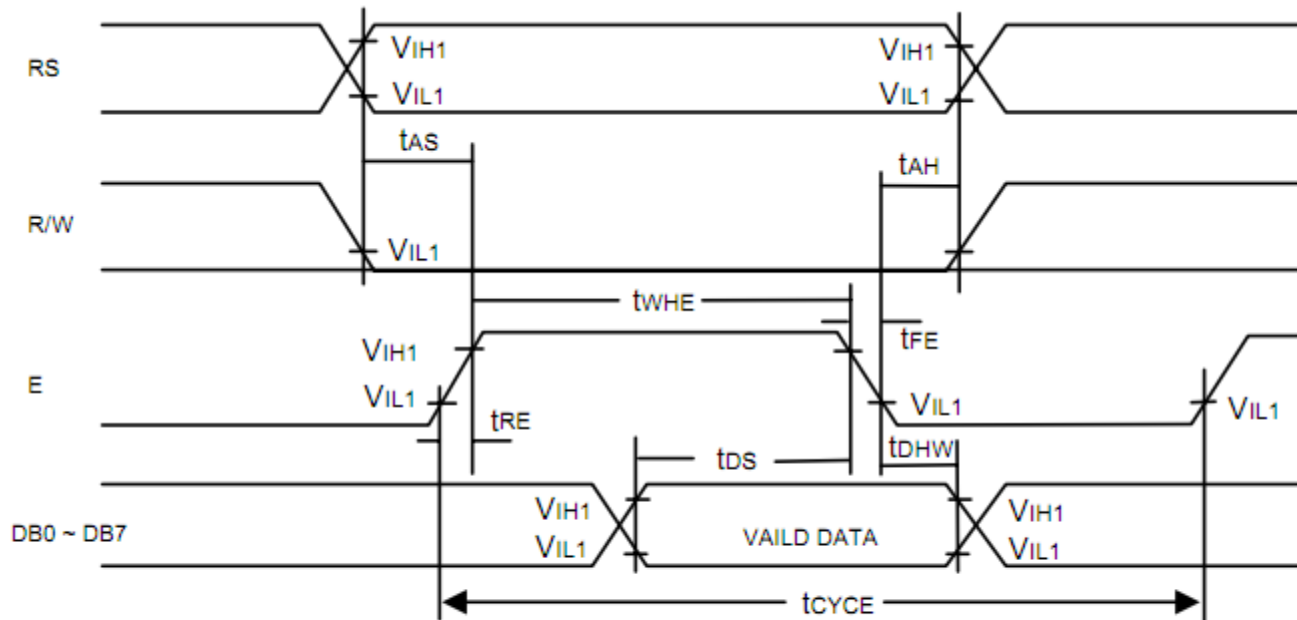


Figure 2. Bus Write Operation Sequence
(Writing data from MPU to NT7605)

Write Cycle ($V_{DD} = 4.5V \sim 5.5V$, $GND = 0V$, $T_A = 25^\circ C$)

Symbol	Parameter	Min.	Typ.	Max.	Unit	Conditions
tCYCE	Enable Cycle Time	500	-	-	ns	Figure 2
tWHE	Enable "H" Level Pulse Width	300	-	-	ns	Figure 2
tRE, tFE	Enable Rise/Fall Time	-	-	25	ns	Figure 2
tAS	RS, R/W Setup Time	60 ¹ 100 ²	-	-	ns	Figure 2
tAH	RS, R/W Address Hold Time	10	-	-	ns	Figure 2
tDS	Data Output Delay	100	-	-	ns	Figure 2
tDHW	Data Hold Time	10	-	-	ns	Figure 2

Notes: 1: 8-bit operation mode
2: 4-bit operation mode

Read from NT7605 to MPU

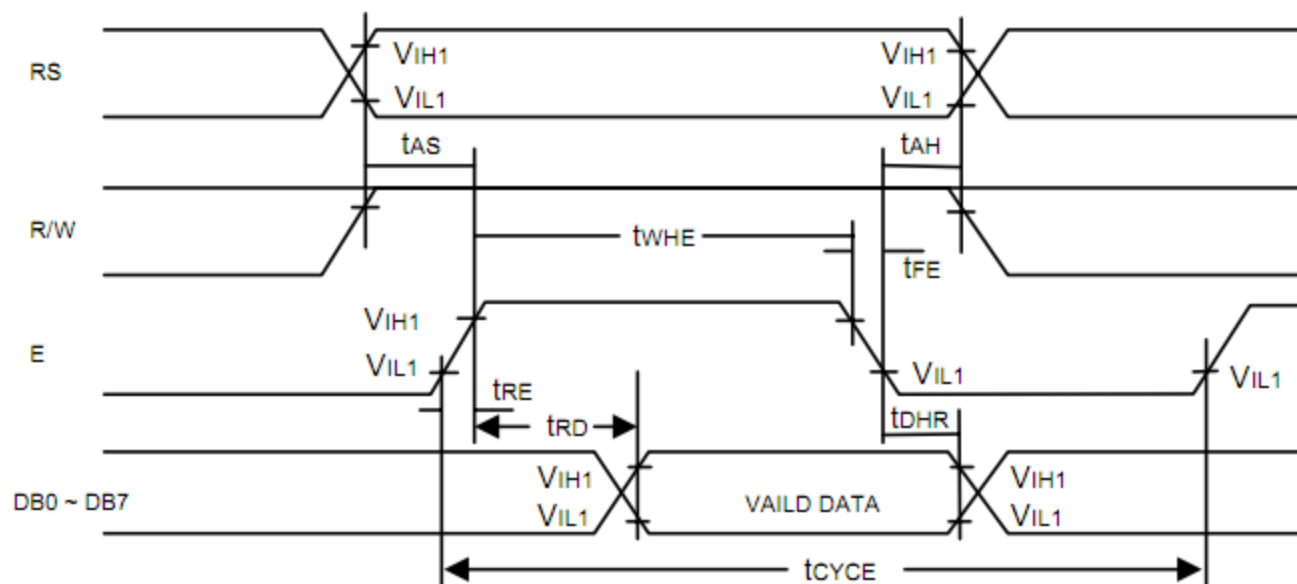


Figure 1. Bus Read Operation Sequence
(Reading out data from NT7605 to MPU)

Read Cycle ($V_{DD} = 4.5V \sim 5.5V$, $GND = 0V$, $T_A = 25^\circ C$)

Symbol	Parameter	Min.	Typ.	Max.	Unit	Conditions
tCYCE	Enable Cycle Time	500	-	-	ns	Figure 1
twHE	Enable "H" Level Pulse Width	300	-	-	ns	Figure 1
tRE, tFE	Enable Rise/Fall Time	-	-	25	ns	Figure 1
tAS	RS, R/W Setup Time	60 ¹	-	-	ns	Figure 1
		100 ²				
tAH	RS, R/W Address Hold Time	10	-	-	ns	Figure 1
tRD	Read Data Output Delay	-	-	190	ns	Figure 1
tDHR	Read Data Hold Time	20	-	-	ns	Figure 1

Notes: 1: 8-bit operation mode

2: 4-bit operation mode

Built-in Font Table

		Higher 4-bit (D4 to D7) of Character Code (Hexadecimal)																
		0	1	2	3	4	5	6	7	8	9	A	B	C	D	E	F	
Lower 4-bit (D0 to D3) of Character Code (Hexadecimal)	0	CG RAM (1)			0	1	2	3	4	5	6	7	8	9	A	B	C	D
	1	CG RAM (2)		!	1	A	0	a	a									
	2	CG RAM (3)		"	2	B	R	b	r									
	3	CG RAM (4)		#	3	C	S	c	s									
	4	CG RAM (5)		\$	4	D	T	t	t									
	5	CG RAM (6)		%	5	E	U	u	u									
	6	CG RAM (7)		&	6	F	V	v	v									
	7	CG RAM (8)		'	7	G	W	w	w									
	8	CG RAM (1)		(	8	H	X	x	x									
	9	CG RAM (2)		)	9	I	Y	y	y									
	A	CG RAM (3)		*	*	J	Z	z	z									
	B	CG RAM (4)		+	+	K	[	k	[									
	C	CG RAM (5)		,	<	L	*	l	l									
	D	CG RAM (6)		-	=	M	]	m	]									
	E	CG RAM (7)		.	>	N	^	n	^									
	F	CG RAM (8)		/	?	O	_	o	+									

Example Initialization Program

```
'INIT-----
A = &H30
Call Writecom                                'wake up
Waitms 100
Call Writecom                                'wake up
Waitms 10
Call Writecom                                'wake up
Waitms 10
A = &H38
'function set
Call Writecom
A = &H10
'shift display=no
Call Writecom
A = &H0C
'display on
Call Writecom
A = &H06
'entry mode set
Call Writecom
'-----
Sub Writecom
P1 = A
Reset P3.0
'instruction
Reset P3.7
'RW
Waitms 1
Set P3.4
'E
Waitms 1
Reset P3.4                                'E
End Sub
'-----
Sub Writedata
P1 = A
Set P3.0
'data
Reset P3.7
'RW
Waitms 1
Set P3.4
'E
Waitms 1
Reset P3.4                                'E
End Sub
'-----
```

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 , 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 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