

# NHD-C0216AZ-FSW-GBW

## COG (Chip-on-Glass) Liquid Crystal Display Module

NHD- Newhaven Display  
C0216- COG, 2 lines x 16 characters  
AZ- Model  
F- Transflective  
SW- Side White LED Backlight  
G- STN- Gray  
B- 6:00 View Angle  
W- Wide Temp (-20 c ~ +70 c)  
**RoHS Compliant**

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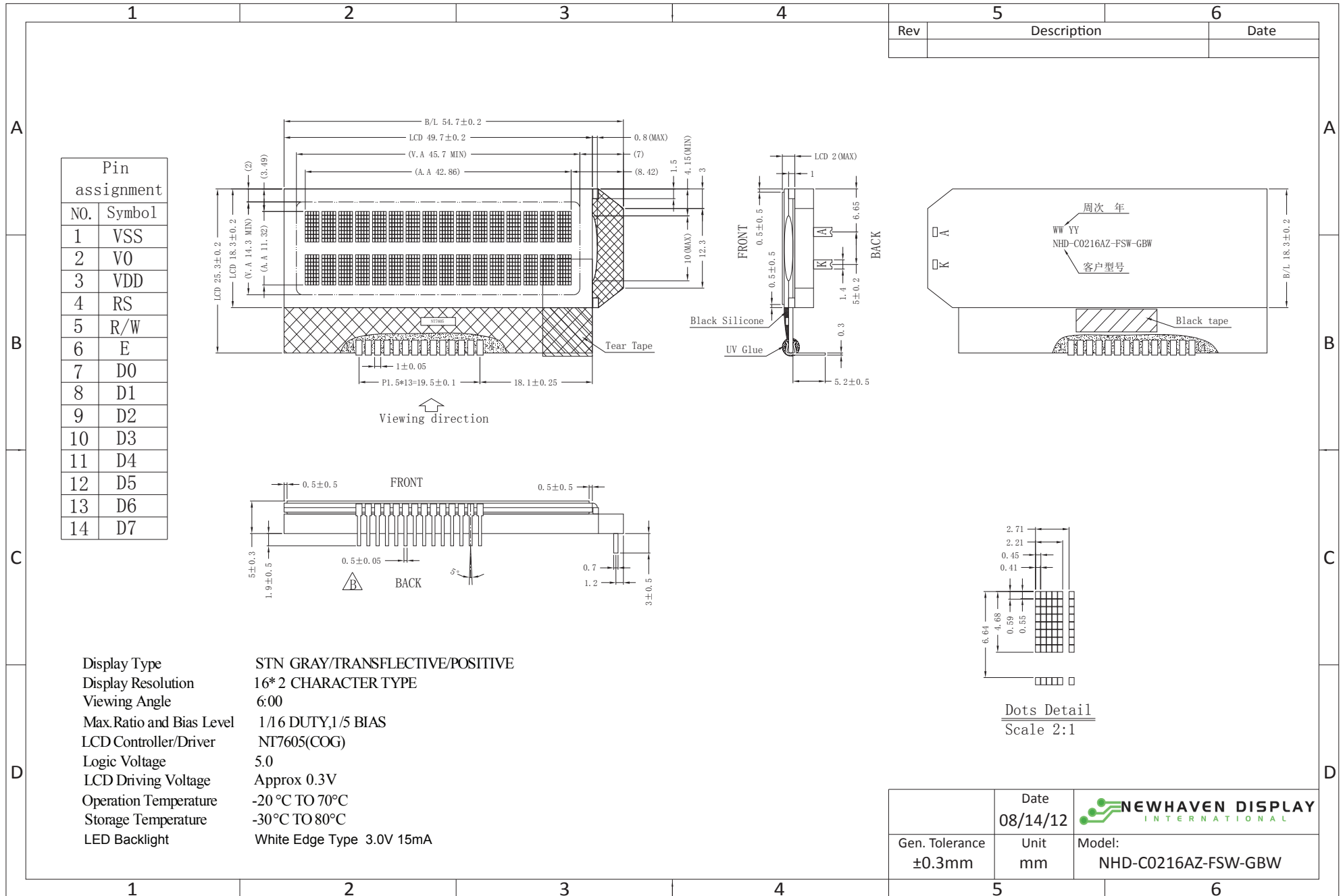
## Document Revision History

Revision	Date	Description	Changed by
0	2/12/2007	Initial Release	
1	2/19/2009	User guide reformat	BE
2	10/9/2009	Updated Electrical Characteristics	MC
3	10/15/2009	Updated Block Diagram	MC
4	6/2/2011	Timing characteristics updated	AK
5	8/14/2012	Mechanical drawing updated	AK

## Functions and Features

- 2 lines x 16 characters
- Built-in NT7605 controller
- 5x8 dots with cursor
- +5V power supply
- 1/16 duty, 1/5 bias
- RoHS Compliant

# Mechanical Drawing

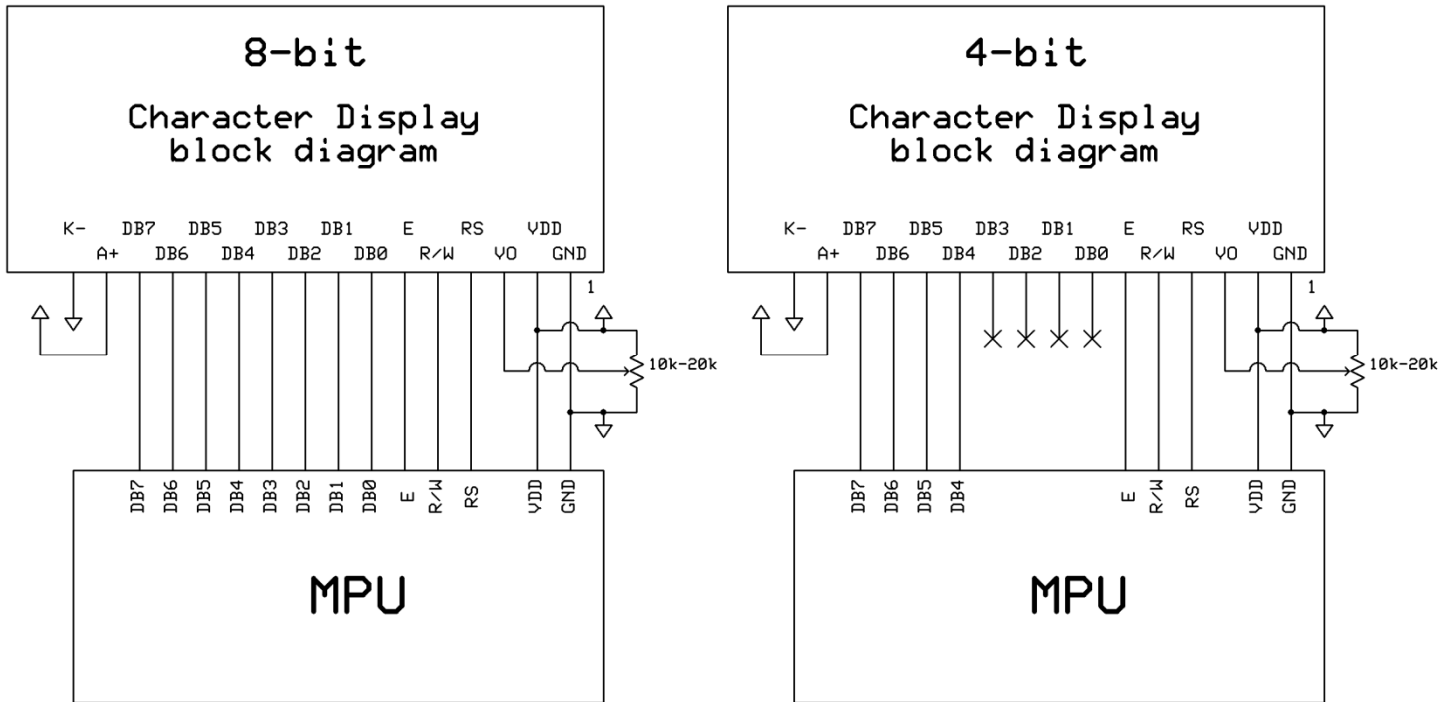


## Pin Description and Wiring Diagram

Pin No.	Symbol	External Connection	Function Description
1	V <sub>SS</sub>	Power Supply	Ground
2	V <sub>O</sub>	Adj. Power supply	Power supply for contrast (approx. 0.3V)
3	V <sub>DD</sub>	Power Supply	Supply voltage for logic (5.0V)
4	R <sub>S</sub>	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		Four low order bi-directional three state data bus lines. These four are not used during 4-bit operation.
11-14	DB4-DB7		Four high order bi-directional three state data bus lines.
15	A	power supply	Power supply for LED Backlight (3.0V)
16	K		Ground for Backlight

**Recommended LCD connector:** 1.5 mm pitch, 14 pins Soldered to PCB

**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	-	+70	°C
Storage Temperature Range	Tst	Absolute Max	-30	-	+80	°C
Supply Voltage	VDD		4.7	5.0	5.5	V
Supply Current	IDD	Ta=25°C, VDD=5.0V	-	1.0	1.5	mA
Supply for LCD (contrast)	VDD-Vo	<b>Ta=25°C</b>	-	4.7	-	V
"H" Level input	VIH		2.2	-	VDD	V
"L" Level input	VIL		0	-	0.6	V
"H" Level output	VoH		2.4	-	-	V
"L" Level output	VoL		-	-	0.4	V
Backlight Supply Voltage	VLED		-	3.0	-	V
Backlight Supply Current	I <sub>LED</sub>	VLED=3.0V		15	20	mA

## Optical Characteristics

Item	Symbol	Condition	Min.	Typ.	Max.	Unit
Viewing Angle - Vertical	AV	Cr ≥ 2	-60	-	+35	°
Viewing Angle - Horizontal	AH	Cr ≥ 2	-40	-	+40	°
Contrast Ratio	Cr		-	6	-	-
Response Time (rise)	Tr	-	-	150	250	ms
Response Time (fall)	Tr	-	-	150	250	ms

## Controller Information

Built-in NT7605. Download specification at [http://www.newhavendisplay.com/app\\_notes/NT7605.pdf](http://www.newhavendisplay.com/app_notes/NT7605.pdf)

## DDRAM address location:

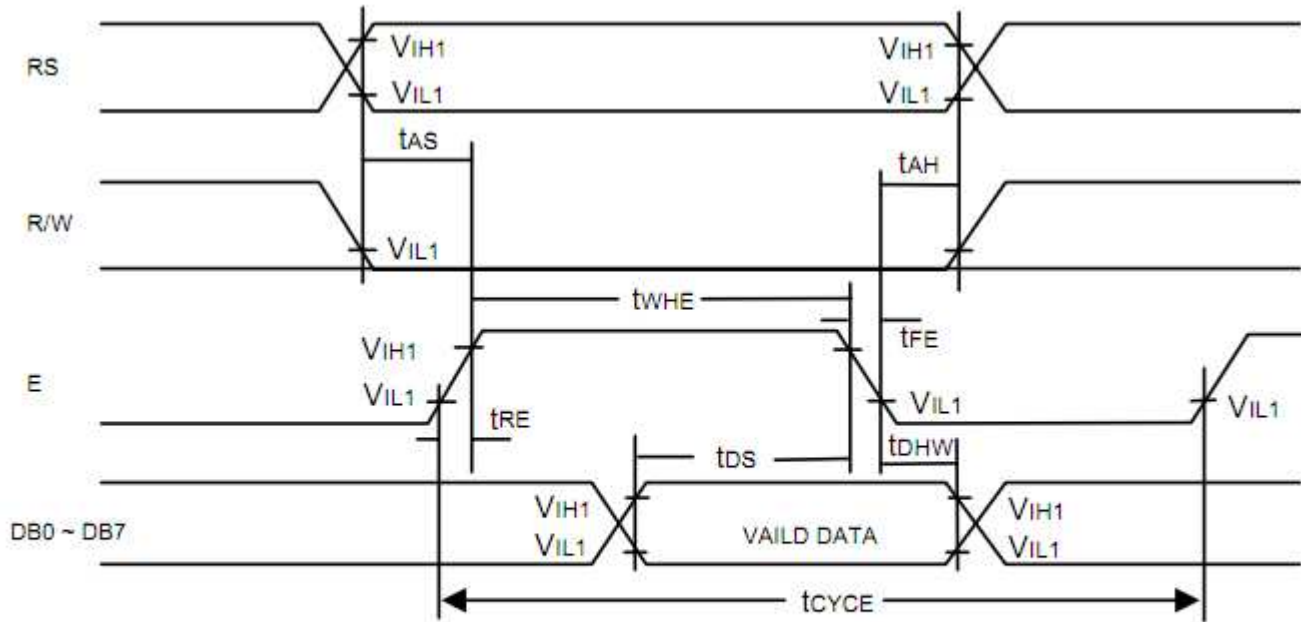
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
00	01	02	03	04	05	06	07	08	09	0A	0B	0C	0D	0E	0F
40	41	42	43	44	45	46	47	48	49	4A	4B	4C	4D	4E	4F

# Table of Commands

Instruction	Code										Function	Execution time (max) (f <sub>osc</sub> = 250KHz)		
	RS	RW	DB7	DB6	DB5	DB4	DB3	DB2	DB1	DB0				
Display Clear	0	0	0	0	0	0	0	0	0	0	1	Clear entire display area, Restore display from shift, and load address counter with DD RAM address 00H.	1.64ms	
Display/ Cursor Home	0	0	0	0	0	0	0	0	0	1	*	Restore display from shift and load address counter with DD RAM address 00H.	1.64ms	
Entry Mode Set	0	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	0	0	0	0	0	0	0	1	D	C	B	Specify activation of display (D) cursor (C) and blinking of character at cursor position (B).	40µs	
Display/ Cursor Shift	0	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 display line (N), and character font (F).	40µs	
RAM Address Set	0	0	0	1	ACG						Load the address counter with a CG RAM address. Subsequent data access is for CG RAM data.	40µs		
DD RAM Address Set	0	0	1	ADD						Load the address counter with a DD RAM address. Subsequent data access is for DD RAM data.	40µs			
Busy Flag/ Address Counter Read	0	1	BF	AC						Read Busy Flag (BF) and contents of Address Counter (AC).	1µs			
CG RAM/ DD RAM Data Write	1	0	Write data						Write data to CG RAM or DD RAM.	40µs				
CG RAM/ DD RAM Data Read	1	1	Read data						Read data from CG RAM or DD RAM.	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 : Signal Line F = 0 : 5x8 dots		DD RAM : Display Data RAM  CG RAM : Character Generator RAM ACG : Character Generator RAM Address ADD : Display Data RAM Address AC : Address Counter	

# Timing Characteristics

## Write Operation



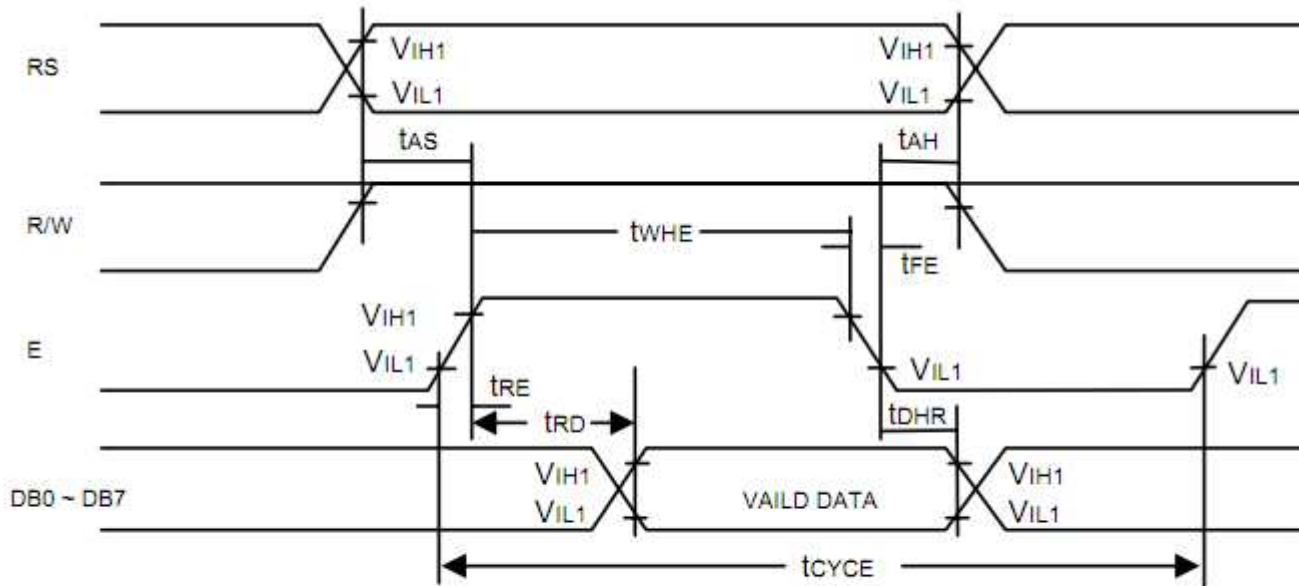
Bus Write Operation Sequence  
(Writing data from MPU to NT7605)

Write Cycle ( $V_{DD} = 5.0V$ ,  $GND = 0V$ ,  $T_A = 25^\circ C$ )

Symbol	Parameter	Min.	Typ.	Max.	Unit	Conditions
$t_{CYCE}$	Enable Cycle Time	500	-	-	ns	Figure 2
$t_{WHE}$	Enable "H" Level Pulse Width	300	-	-	ns	Figure 2
$t_{RE}$ , $t_{FE}$	Enable Rise/Fall Time	-	-	25	ns	Figure 2
$t_{AS}$	RS, R/W Setup Time	$60^1$	-	-	ns	Figure 2
		$100^2$				
$t_{AH}$	RS, R/W Address Hold Time	10	-	-	ns	Figure 2
$t_{DS}$	Data Output Delay	100	-	-	ns	Figure 2
$t_{DHW}$	Data Hold Time	10	-	-	ns	Figure 2

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

## Read Operation



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

Read Cycle ( $V_{DD} = 5.0V$ ,  $GND = 0V$ ,  $T_A = 25^\circ C$ )

Symbol	Parameter	Min.	Typ.	Max.	Unit	Conditions
t <sub>CYCE</sub>	Enable Cycle Time	500	-	-	ns	Figure 1
t <sub>WHE</sub>	Enable "H" Level Pulse Width	300	-	-	ns	Figure 1
t <sub>RE</sub> , t <sub>FE</sub>	Enable Rise/Fall Time	-	-	25	ns	Figure 1
t <sub>AS</sub>	RS, R/W Setup Time	60 <sup>1</sup>	-	-	ns	Figure 1
		100 <sup>2</sup>				
t <sub>AH</sub>	RS, R/W Address Hold Time	10	-	-	ns	Figure 1
t <sub>RD</sub>	Read Data Output Delay	-	-	190	ns	Figure 1
t <sub>DHR</sub>	Read Data Hold Time	20	-	-	ns	Figure 1

Notes: 1: 8-bit operation mode

2: 4-bit operation mode



## 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	a	P	`	P				-	夕	ミ	α	ρ
xxxx0001	(2)		!	1	A	Q	a	q			。	ア	チ	△	ä	q
xxxx0010	(3)		"	2	B	R	b	r			「	イ	ツ	×	ß	θ
xxxx0011	(4)		#	3	C	S	c	s			」	ウ	テ	モ	ε	∞
xxxx0100	(5)		\$	4	D	T	d	t			、	エ	ト	ト	μ	Ω
xxxx0101	(6)		%	5	E	U	e	u			・	オ	ナ	1	ε	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			イ	ク	ネ	リ	γ	∞
xxxx1001	(2)		)	9	I	Y	i	y			ウ	ケ	ル	ル	ˆ	γ
xxxx1010	(3)		*	:	J	Z	j	z			エ	コ	ハ	レ	j	≠
xxxx1011	(4)		+	;	K	[	k	{			オ	サ	ヒ	ロ	*	≠
xxxx1100	(5)		,	<	L	¥	l				カ	シ	フ	ク	φ	≠
xxxx1101	(6)		-	=	M	]	m	}			ユ	ス	ハ	ン	≠	÷
xxxx1110	(7)		.	>	N	^	n	→			ヨ	セ	ホ	°	≠	
xxxx1111	(8)		/	?	O	_	o	+			ッ	リ	マ	°	ö	■

## 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 , 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](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)

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- Изготовление тестовой платы монтаж и пусконаладочные работы.



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