

# 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 Positive, Gray  
B- 6:00 Optimal View  
W- Wide Temp  
**RoHS Compliant**

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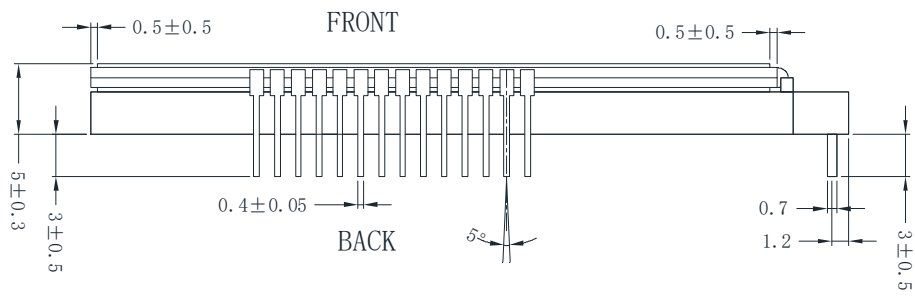
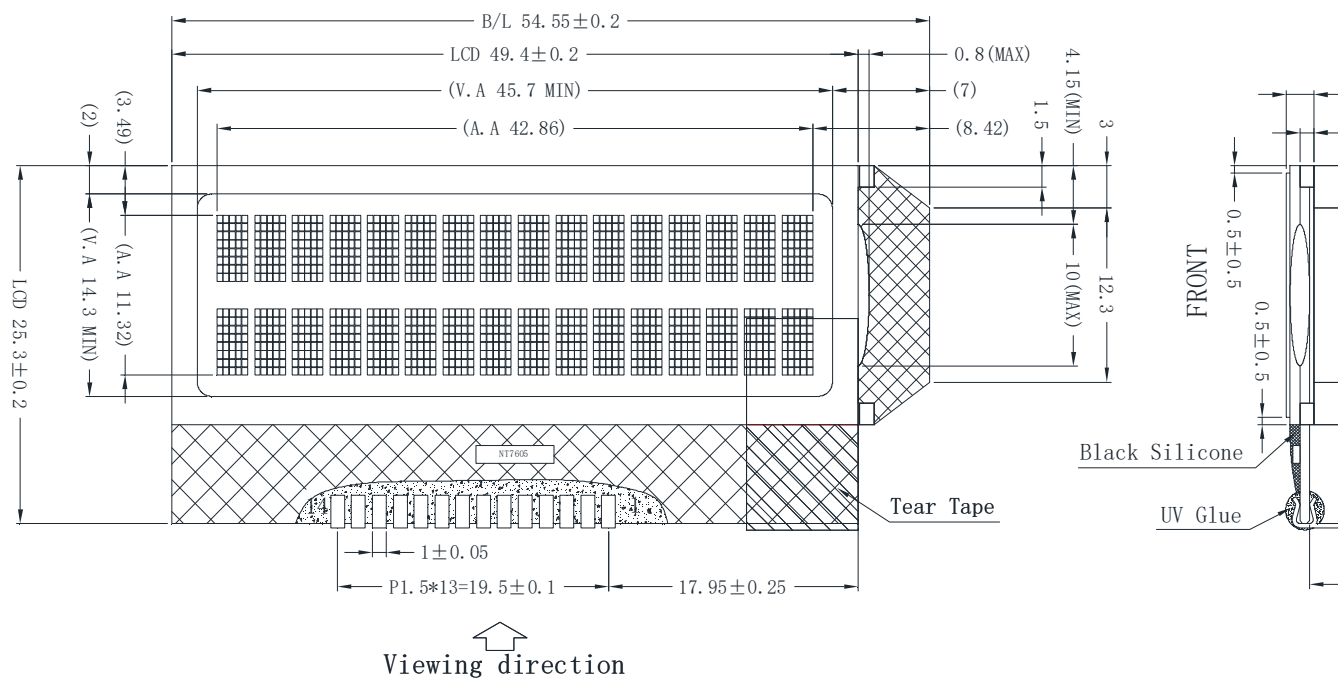
## Document Revision History

Revision	Date	Description	Changed by
0	2/12/07	Initial Release	-
1	2/19/09	User guide reformat	BE
2	10/9/09	Updated Electrical Characteristics	MC
3	10/15/09	Updated Block Diagram	MC
4	6/2/11	Timing characteristics updated	AK
5	8/14/12	Mechanical drawing updated	AK
6	9/16/14	Electrical Characteristics updated	ML
7	7/15/16	Pin Length Modified	SB
8	3/8/17	Electrical Characteristics	SB
9	4/14/17	Mechanical Drawing & I <sub>LED</sub> Updated	SB
10	3/6/18	Supply Current Updated	SB
11	6/24/19	Added PCB Footprint Drawing	AS
12	2/19/20	Glass Panel Updated	SB

## 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

A  
B  
C  
D  
E  
F



Notes:

- 1. Driver: 1/16 Duty, 1/5 Bias
- 2. Voltage: 5.0V VDD, 4.7V VLCD
- 3. Display Mode: STN Positive / Gray / Transflective
- 4. Optimal View: 6:00
- 5. Backlight: White LED
- 6. Driver IC: NT7605H-BDT01 8/4-Bit MPU Interface

1 2 3 4

# A Recommended PCB Footprint

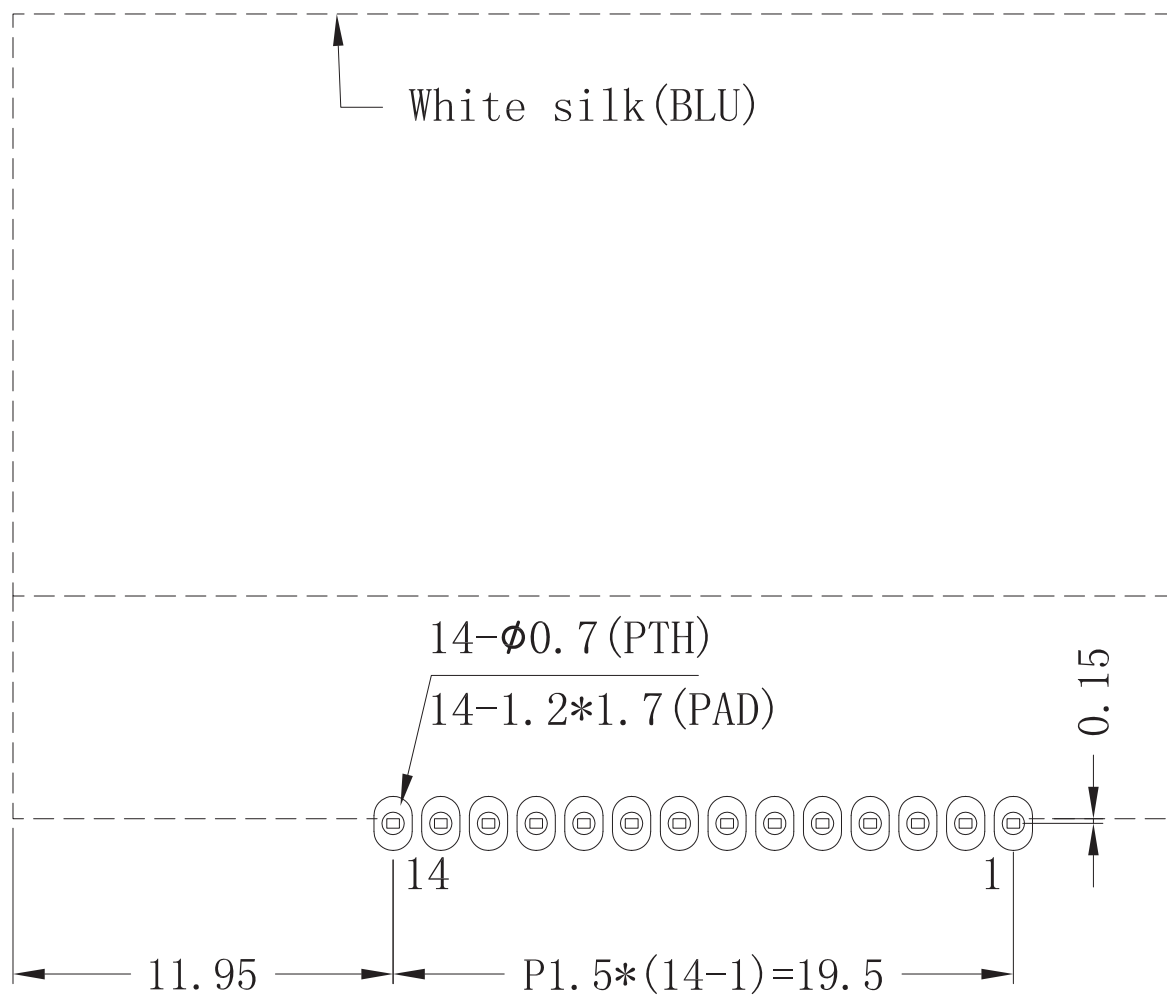
B

C

D

E

F



**Applicable Displays:**  
1) NHD-C0216AZ-FSW-GBW

1

2

3

4

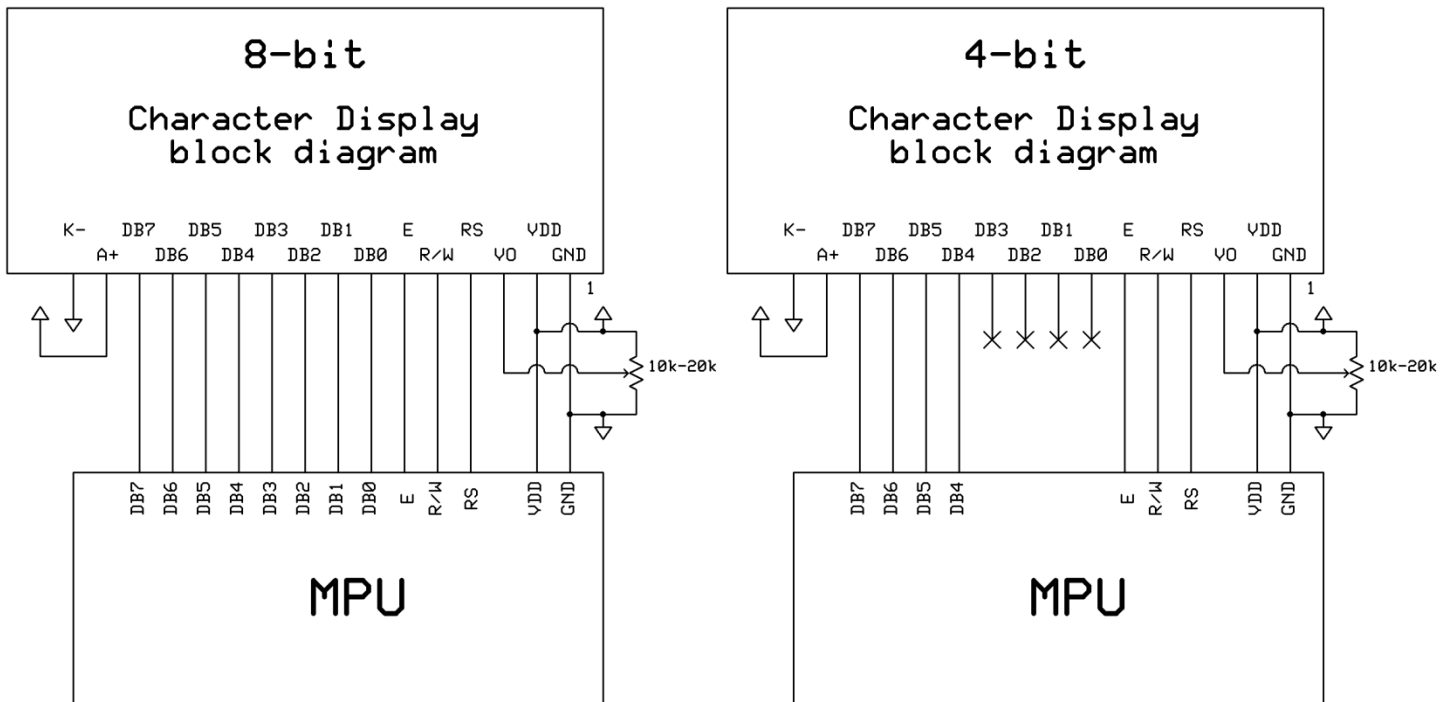
## Pin Description and Wiring Diagram

Pin No.	Symbol	External Connection	Function Description
1	V <sub>SS</sub>	Power Supply	Ground
2	V <sub>0</sub>	Adj. Power supply	Supply Voltage 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	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	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

**Recommended Breakout Board:** [NHD-PCB40](#)



## Electrical Characteristics

Item	Symbol	Condition	Min.	Typ.	Max.	Unit
Operating Temperature Range	T <sub>OP</sub>	Absolute Max	-20	-	+70	°C
Storage Temperature Range	T <sub>ST</sub>	Absolute Max	-30	-	+80	°C
Supply Voltage	V <sub>DD</sub>	-	4.5	5.0	5.5	V
Supply Current	I <sub>DD</sub>	V <sub>DD</sub> = 5.0V	0.6	2	3	mA
Supply for LCD (contrast)	V <sub>LCD</sub>	T <sub>OP</sub> = 25°C	4.4	4.7	5.0	V
"H" Level input	V <sub>IH</sub>	-	0.8 * V <sub>DD</sub>	-	V <sub>DD</sub>	V
"L" Level input	V <sub>IL</sub>	-	V <sub>SS</sub>	-	0.2 * V <sub>DD</sub>	V
"H" Level output	V <sub>OH</sub>	-	V <sub>DD</sub> - 0.6	-	V <sub>DD</sub>	V
"L" Level output	V <sub>OL</sub>	-	V <sub>SS</sub>	-	V <sub>SS</sub> + 0.6	V
Backlight Supply Current	I <sub>LED</sub>	-	-	15	23	mA
Backlight Supply Voltage	I <sub>LED</sub>	I <sub>LED</sub> = 15 mA	2.8	3.0	3.2	mA

\*The LED of the backlight is driven by current drain; drive voltage is for reference only. Drive voltage must be selected to ensure backlight current drain is below MAX level stated.

## Optical Characteristics

Item	Symbol	Condition	Min.	Typ.	Max.	Unit
Optimal Viewing Angles	Top	CR ≥ 2	-	35	-	°
	Bottom		-	60	-	°
	Left		-	40	-	°
	Right		-	40	-	°
Contrast Ratio	CR	-	2	6	-	-
Response Time	Rise	T <sub>OP</sub> = 25°C	-	150	250	ms
	Fall		-	150	250	ms

## Controller Information

Built-in NT7605 Controller.

Please download specification at [http://www.newhavendisplay.com/app\\_notes/NT7605.pdf](http://www.newhavendisplay.com/app_notes/NT7605.pdf)

## DDRAM Address

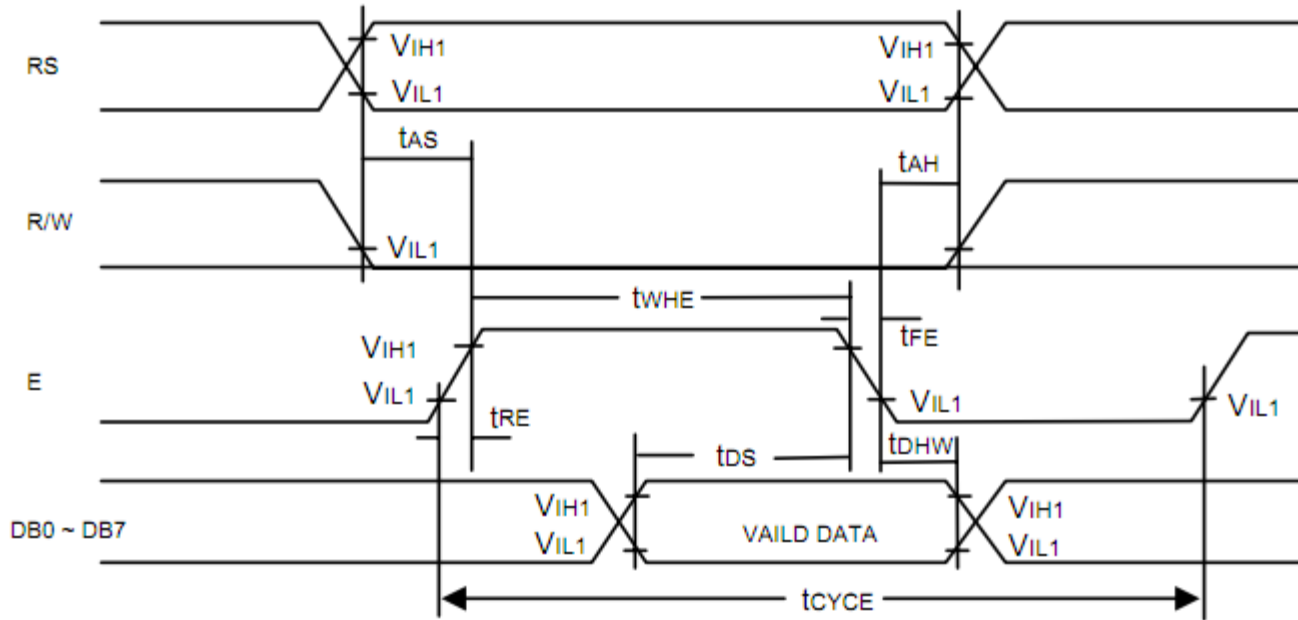
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
00	01	02	03	04	05	06	07	08	09	0A	0B	0C	0D	0E	0F
40	41	42	43	44	45	46	47	48	49	4A	4B	4C	4D	4E	4F

## Table of Commands

Instruction	Code										Function	Execution time (max) (fosc = 540KHz)
	RS	RW	DB7	DB6	DB5	DB4	DB3	DB2	DB1	DB0		
Display Clear	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	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	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	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	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						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                      I/D = 0 : Decrement S = 1 : Display Shift On D = 1 : Display On C = 1 : Cursor Display On B = 1 : Cursor Blink On S/C = 1 : Shift Display                      S/C = 0 : Move Cursor R/L = 1 : Shift Right                      R/L = 0 : Shift Left DL = 1 : 8-Bit                                  DL = 0 : 4-Bit N = 1 : Dual Line                              N = 0 : Signal Line F = 1 : 5x10 dots                              F = 0 : 5x8 dots BF = 1 : Internal Operation BF = 0 : Ready for Instruction										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)

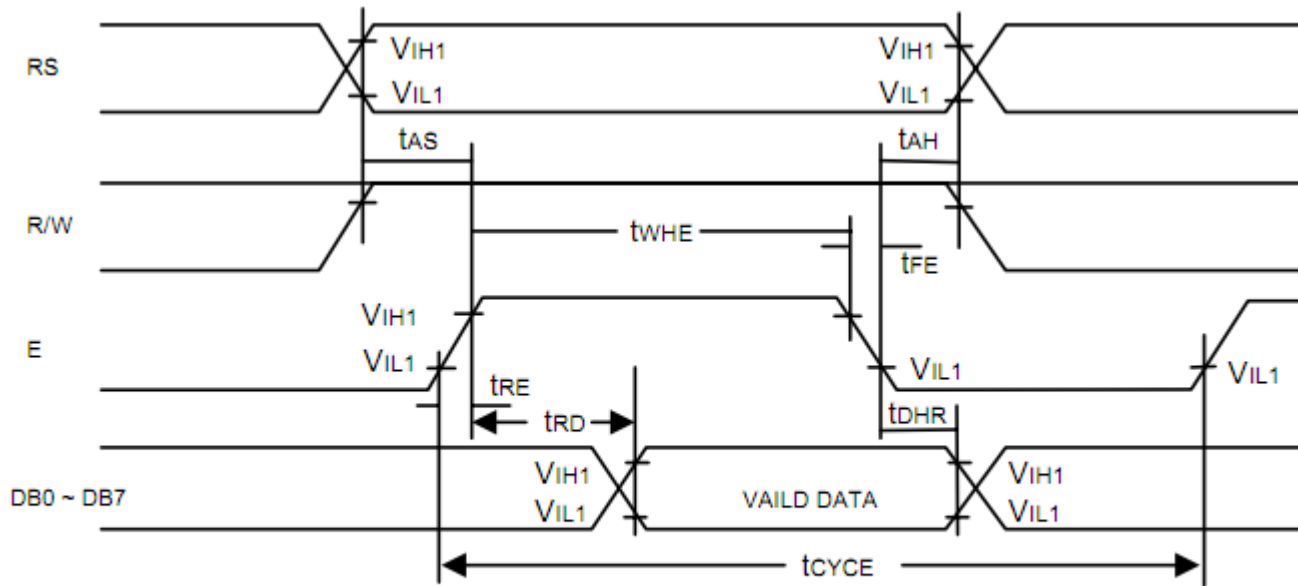
Write Cycle ( $V_{DD} = 5.0V$ ,  $GND = 0V$ ,  $T_A = 25^\circ C$ )

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 <sup>1</sup>	-	-	ns	Figure 2
		100 <sup>2</sup>				
$t_{AH}$	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
$t_{CYCE}$	Enable Cycle Time	500	-	-	ns	Figure 1
$t_{wHE}$	Enable "H" Level Pulse Width	300	-	-	ns	Figure 1
$t_{RE}, t_{FE}$	Enable Rise/Fall Time	-	-	25	ns	Figure 1
$t_{AS}$	RS, R/W Setup Time	$60^1$	-	-	ns	Figure 1
		$100^2$				
$t_{AH}$	RS, R/W Address Hold Time	10	-	-	ns	Figure 1
$t_{RD}$	Read Data Output Delay	-	-	190	ns	Figure 1
$t_{DHR}$	Read Data Hold Time	20	-	-	ns	Figure 1

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

# Built-in Font Table

b7-b4 b3-b0	0000	0001	0010	0011	0100	0101	0110	0111	1000	1001	1010	1011	1100	1101	1110	1111
0000	CG RAM (1)			0	a	P	^	P				—	9	3	a	p
0001	(2)		!	1	A	Q	a	A			•	7	7	G	ã	q
0010	(3)		"	2	B	R	b	r			ˆ	4	9	×	B	ø
0011	(4)		#	3	C	S	c	s			ˆ	9	7	e	3	×
0100	(5)		\$	4	D	T	d	t			ˆ	1	1	h	µ	a
0101	(6)		%	5	E	U	e	u			ˆ	1	6	1	0	0
0110	(7)		&	6	F	V	f	v			ˆ	0	2	3	p	Σ
0111	(8)		'	7	G	W	g	w			ˆ	7	7	7	g	π
1000	(1)		(	8	H	X	h	x			ˆ	0	*	9	7	Σ
1001	(2)		)	9	I	Y	i	y			ˆ	0	7	7	7	9
1010	(3)		*	:	J	Z	j	z			ˆ	0	0	0	7	7
1011	(4)		+	:	K	L	k	l			ˆ	*	9	0	0	π
1100	(5)		,	<	L	*	l	l			ˆ	9	0	0	0	π
1101	(6)		—	=	M	J	m	j			ˆ	0	Σ	0	l	÷
1110	(7)		.	>	N	^	n	→			ˆ	0	0	0	π	
1111	(8)		/	?	O	_	o	←			ˆ	0	0	0	0	■

## 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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