

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 Optimal View
W-	Wide Temp
	RoHS Compliant

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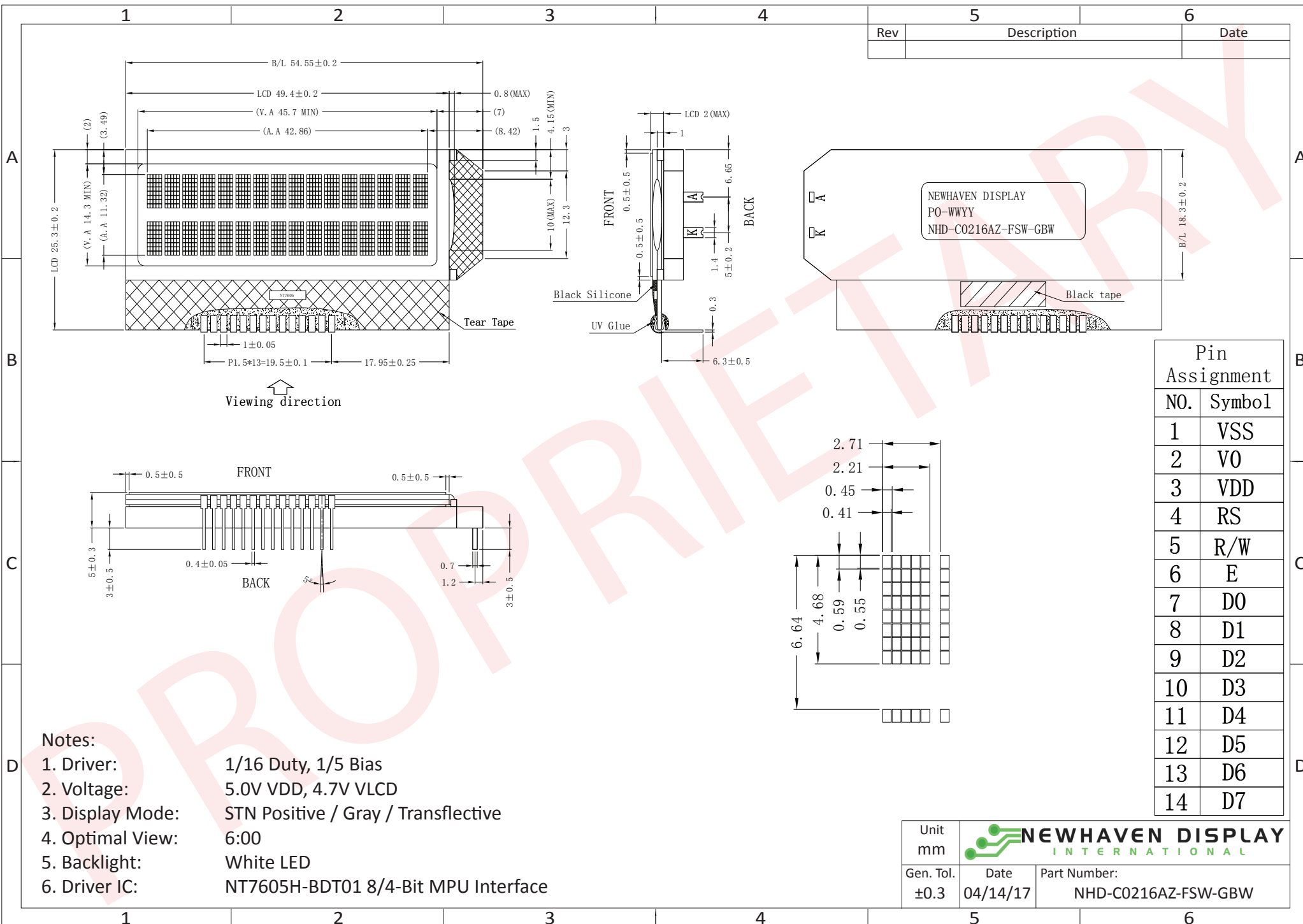
Document Revision History

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 _{LED} 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

Mechanical Drawing

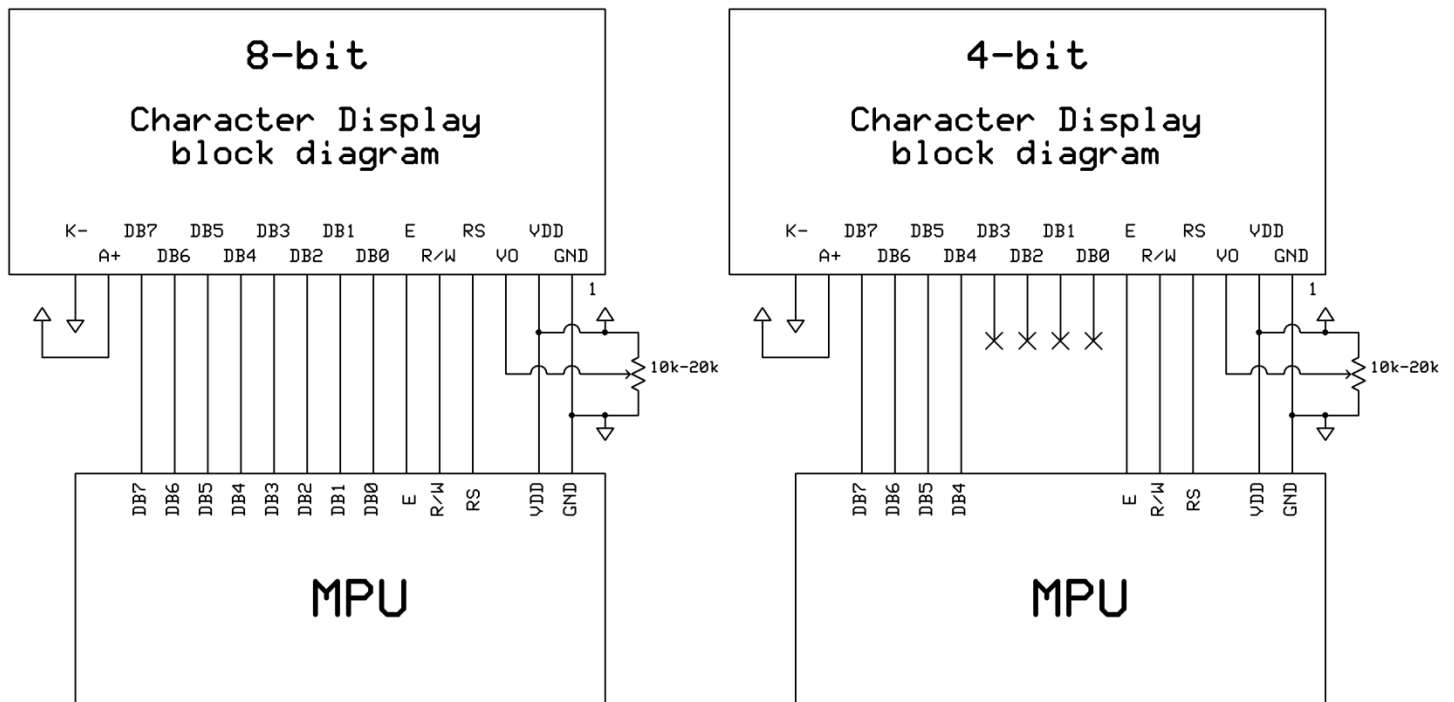


Pin Description and Wiring Diagram

Pin No.	Symbol	External Connection	Function Description
1	V_{SS}	Power Supply	Ground
2	V_0	Adj. Power supply	Supply Voltage for contrast (approx. 0.3V)
3	V_{DD}	Power Supply	Supply voltage for logic (5.0V)
4	R_s	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



Electrical Characteristics

Item	Symbol	Condition	Min.	Typ.	Max.	Unit
Operating Temperature Range	T _{OP}	Absolute Max	-20	-	+70	°C
Storage Temperature Range	T _{ST}	Absolute Max	-30	-	+80	°C
Supply Voltage	V _{DD}	-	4.5	5.0	5.5	V
Supply Current	I _{DD}	V _{DD} = 5.0V T _{OP} = 25°C	0.5	2	3	mA
Supply for LCD (contrast)	V _{LCD}		4.4	4.7	5.0	V
"H" Level input	V _{IH}	-	0.8 * V _{DD}	-	V _{DD}	V
"L" Level input	V _{IL}	-	V _{SS}	-	0.2 * V _{DD}	V
"H" Level output	V _{OH}	-	V _{DD} - 0.6	-	V _{DD}	V
"L" Level output	V _{OL}	-	V _{SS}	-	V _{SS} + 0.6	V
Backlight Supply Current	I _{LED}	-	-	15	20	mA
Backlight Supply Voltage	I _{LED}	I _{LED} = 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	φY+	CR ≥ 2	-	35	-	°
	Bottom	φY-		-	60	-	°
	Left	θX-		-	40	-	°
	Right	θX+		-	40	-	°
Contrast Ratio		CR	-	2	6	-	-
Response Time	Rise	T _R	T _{OP} = 25°C	-	150	250	ms
	Fall	T _F		-	150	250	ms

Controller Information

Built-in NT7605 Controller.

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

DDRAM Address

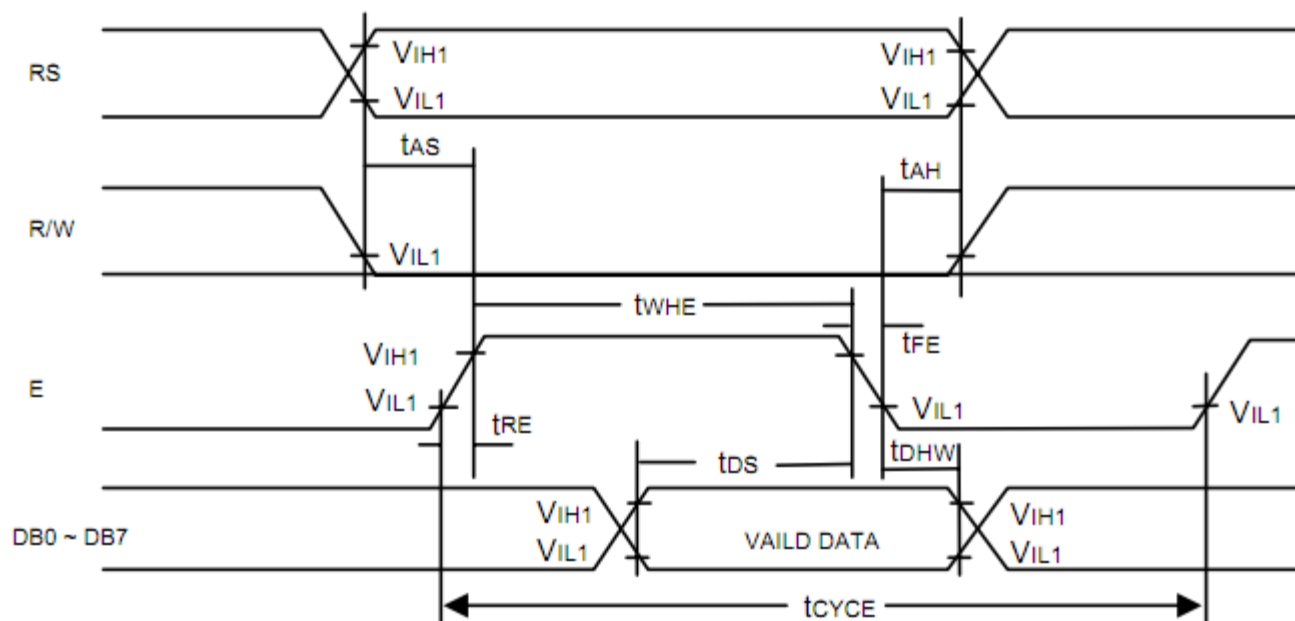
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
00	01	02	03	04	05	06	07	08	09	0A	0B	0C	0D	0E	0F
40	41	42	43	44	45	46	47	48	49	4A	4B	4C	4D	4E	4F

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 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



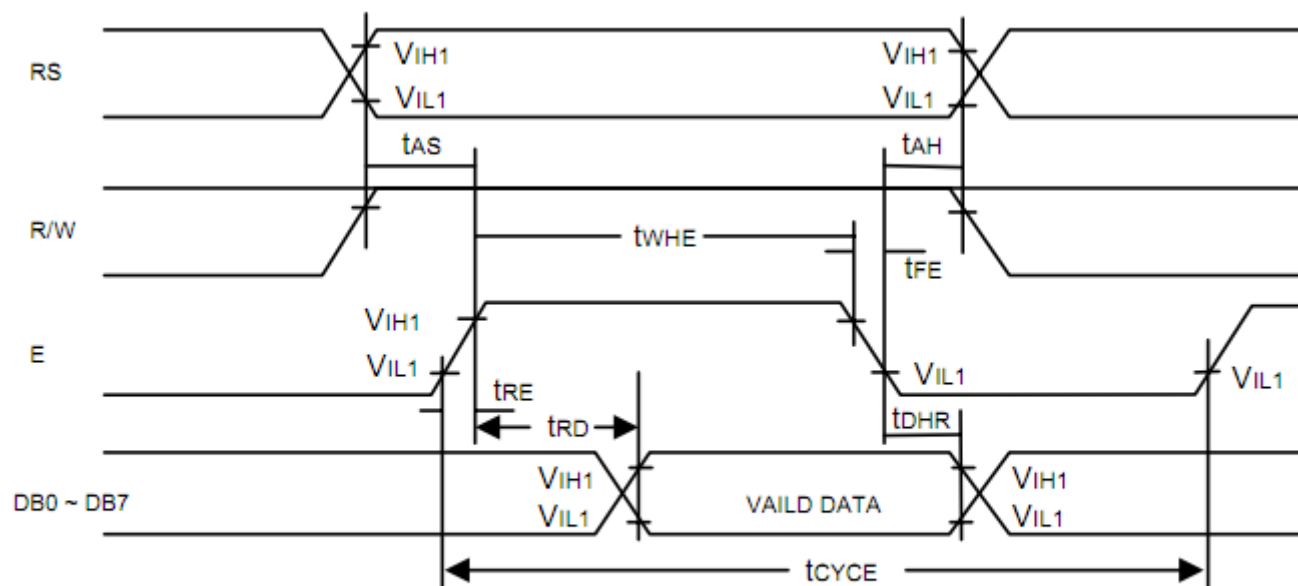
Bus Write Operation Sequence
(Writing data from MPU to NT7605)

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

Symbol	Parameter	Min.	Typ.	Max.	Unit	Conditions
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	-	-	ns	Figure 2
		100 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 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	˘	F				—	9	3	a	p	
0001	(2)		!	1	A	Q	a	9				•	7	7	4	ä	q
0010	(3)		"	2	B	R	b	r				"	4	W	×	ß	ø
0011	(4)		#	3	C	S	c	s				┘	9	7	e	ε	×
0100	(5)		\$	4	D	T	d	t				√	I	t	þ	µ	α
0101	(6)		%	5	E	U	e	u				•	†	†	1	ε	0
0110	(7)		&	6	F	V	f	v				7	カ	二	ヨ	ρ	Σ
0111	(8)		'	7	G	W	g	w				7	†	又	9	g	π
1000	(1)		(	8	H	X	h	x				4	9	*	リ	フ	×
1001	(2)		)	9	I	Y	i	y				9	7	ノ	ル	˘	y
1010	(3)		*	:	J	Z	j	z				±	コ	∩	レ	j	≠
1011	(4)		+	:	K	L	k	l				*	9	ヒ	ロ	×	≠
1100	(5)		,	<	L	¥	l	l				•	9	フ	ワ	•	≠
1101	(6)		—	=	N	I	n	}				ユ	ズ	˘	ソ	ト	÷
1110	(7)		.	>	N	^	n	→				ヨ	ヒ	ホ	˘	ル	
1111	(8)		/	?	O	_	o	←				9	9	マ	"	6	■

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

Warranty Information and Terms & Conditions

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