

NHD-C0216CU-FSW-GBW-3V3

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

NHD- Newhaven Display
C0216- COG, 2 Lines x 16 Characters
CU- Model
F- Transflective
SW- Side White LED Backlight
G- STN Positive, Gray
B- 6:00 Optimal View
W- Wide Temp
3V3- 3VDD, 3.2V Backlight
RoHS Compliant

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Document Revision History

Revision	Date	Description	Changed by
0	8/29/08	Initial Release	-
1	9/10/09	User guide reformat	BE
2	10/9/09	Updated Electrical Characteristics	MC
3	10/22/09	Mechanical Drawing dimensions added	BE
4	11/19/09	Updated backlight current	MC
5	8/5/10	Electrical Characteristics Update	MP
6	5/17/11	Updated Pin Description	BE
7	7/26/12	Mechanical drawing updated	AK
8	5/18/16	Mechanical Drawing, Electrical and Optical Char. Updated	SB
9	2/17/17	Backlight Characteristics Updated	SB
10	6/24/19	Added PCB Footprint Drawing	AS
11	9/4/19	Mechanical Drawing, Footprint & Current Updated	SB

Functions and Features

- 2 lines x 16 characters
- Built-in ST7032-0D controller
- +3.0V power supply
- 8-bit parallel data input from MPU
- 1/16 duty, 1/5 bias
- No CGRAM available
- RoHS Compliant

A

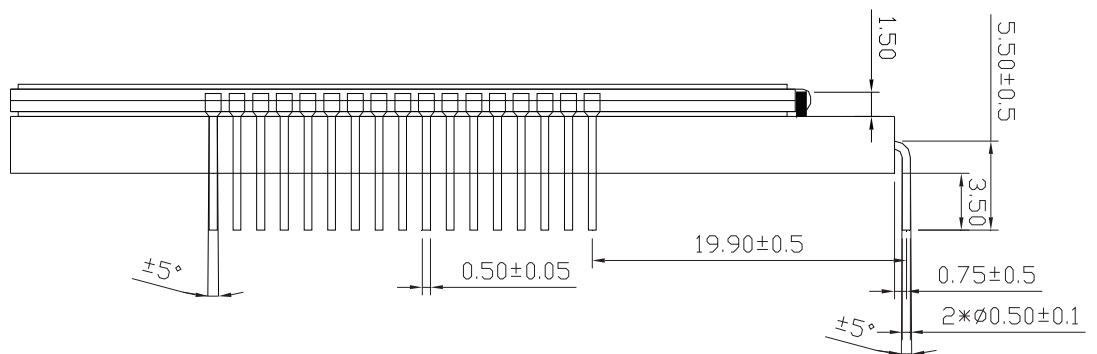
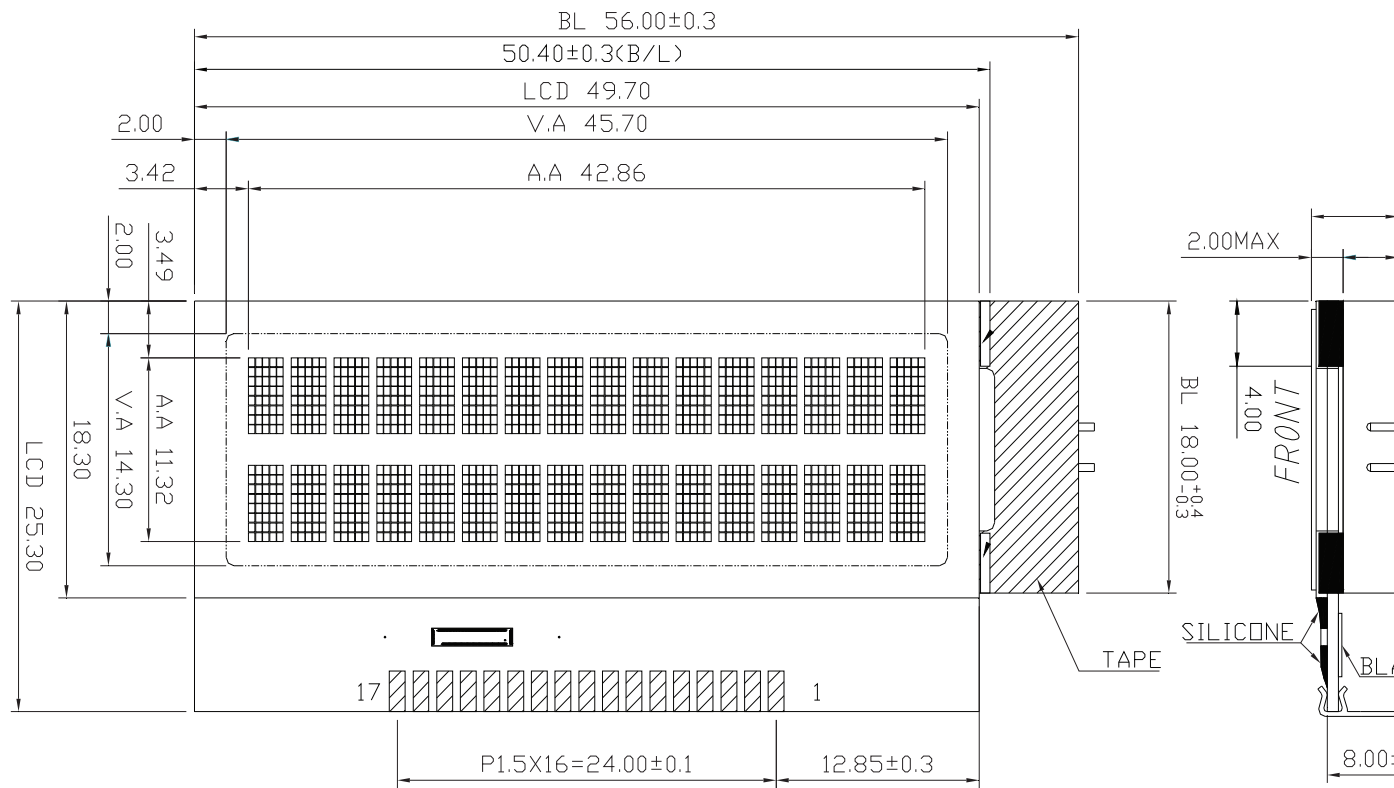
B

C

D

E

F



Notes:

- 1. Driver: 1/16 Duty, 1/5 Bias
- 2. Voltage: 3V V_{DD}, 5V V_{LCD}
- 3. Display Mode: STN Positive / Gray / Transflective
- 4. Optimal View: 6:00
- 5. Backlight: White LED
- 6. Driver IC: ST7032i-0D - 8/4 Bit Parallel Interface

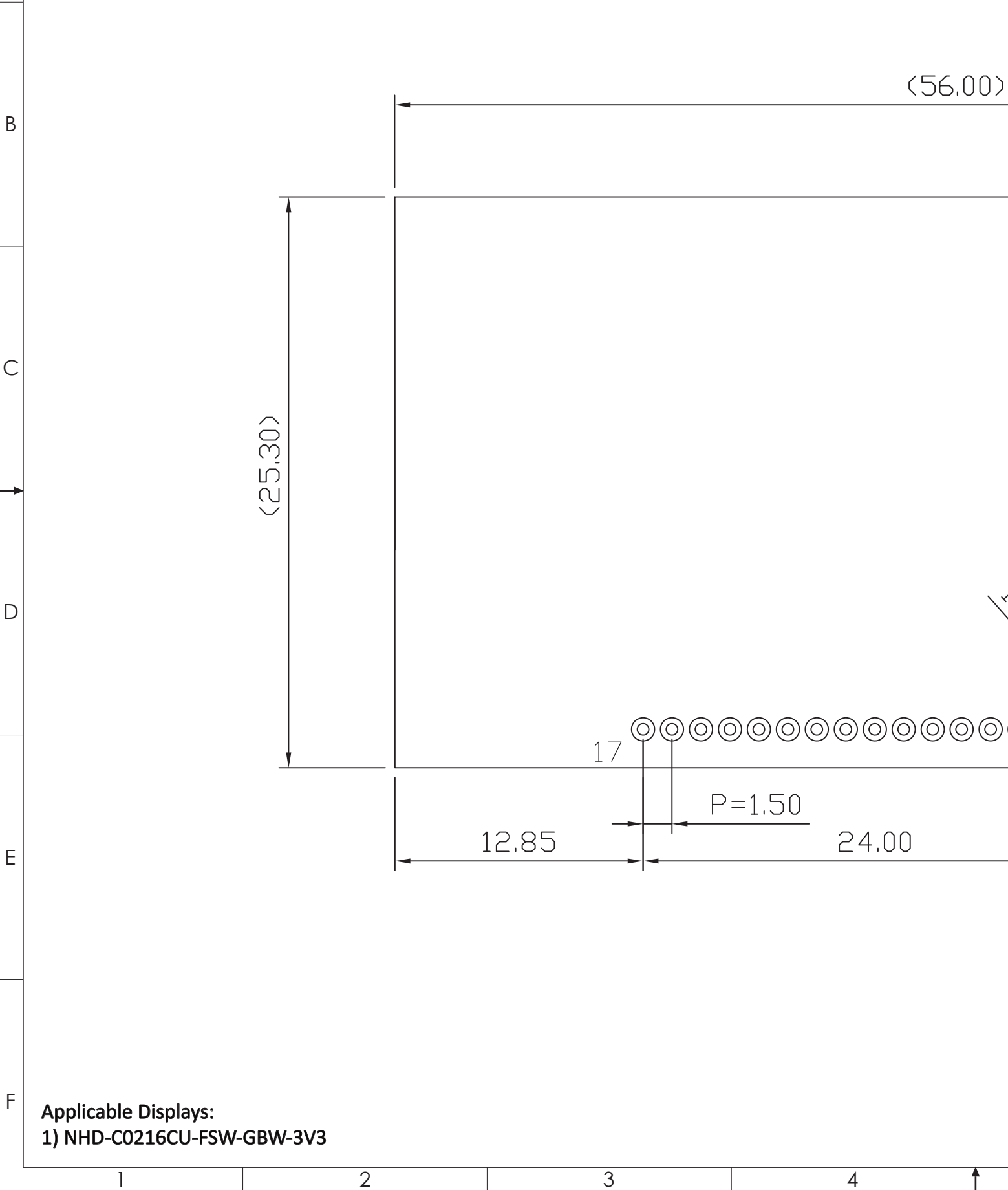
1

2

3

4

A Recommended PCB Footprint



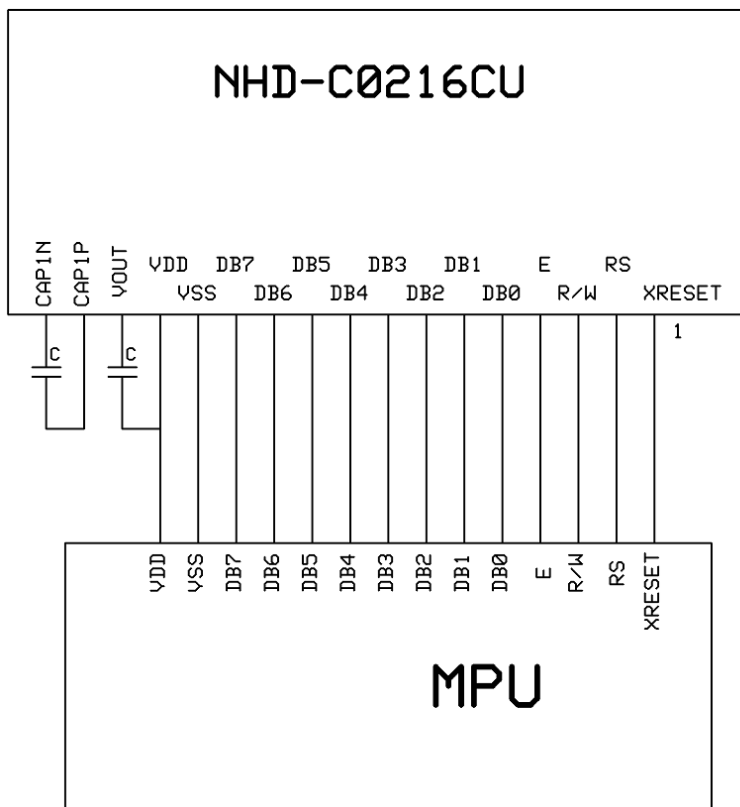
Pin Description and Wiring Diagram

Pin No.	Symbol	External Connection	Function Description
1	XRESET	MPU	Active LOW Reset Signal
2	RS	MPU	Register Select signal. RS=0: instruction; RS=1: data
3	R/W	MPU	Read/Write select signal, R/W=1: Read R/W: =0: Write
4	E	MPU	Operation Enable signal. Falling edge triggered.
5-12	DB0-DB7	MPU	8-bit bi-directional data bus lines
13	V _{SS}	Power Supply	Ground
14	V _{DD}		Supply Voltage for logic for LCD (+3.0V)
15	V _{OUT}		DC/DC voltage converter. Connect to 1uF capacitor to V _{DD}
16	CAP1P		Voltage booster circuit. Connect to 0.47uF-2.2uF cap to PIN17.
17	CAP1N		Voltage booster circuit. Connect to 0.47uF-2.2uF cap to PIN16.
A	LED+	Power Supply	Power supply for Backlight (20mA)
K	LED-	Power Supply	Backlight Ground

Recommended LCD connector: 1.5mm pitch pins, solder to PCB

Backlight connector: --- Mates with: - - -

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



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}	-	2.7	3.0	3.5	V
Supply Current	I _{DD}	V _{DD} = 3.0V	150	300	600	μA
Supply for LCD (contrast)	V _{LCD}	T _{OP} = 25°C	4.7	5.0	5.3	V
"H" Level input	V _{IH}	-	0.7 * V _{DD}	-	V _{DD}	V
"L" Level input	V _{IL}	-	V _{SS}	-	0.2 * V _{DD}	V
"H" Level output	V _{OH}	-	0.75 * V _{DD}	-	V _{DD}	V
"L" Level output	V _{OL}	-	V _{SS}	-	0.8	V
Backlight Supply Current*	I _{LED}	-	-	20	25	mA
Backlight Voltage	V _{LED}	I _{LED} = 20mA	2.8	3.2	3.4	V

*Backlight is current driven; do not supply more than 30 mA. Luminance is directly related to Backlight Supply Current.

Optical Characteristics

Item	Symbol	Condition	Min.	Typ.	Max.	Unit
Optimal Viewing Angle	Top	φY+	-	30	-	°
	Bottom	φY-	-	40	-	°
	Left	θX-	-	40	-	°
	Right	θX+	-	40	-	°
Contrast Ratio	CR	-	2	5	-	-
Response Time	Rise	T _R	-	90	100	ms
	Fall	T _F	-	110	180	ms

Controller Information

Built-in ST7032 Controller.

Please download specification at http://www.newhavendisplay.com/app_notes/ST7032.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

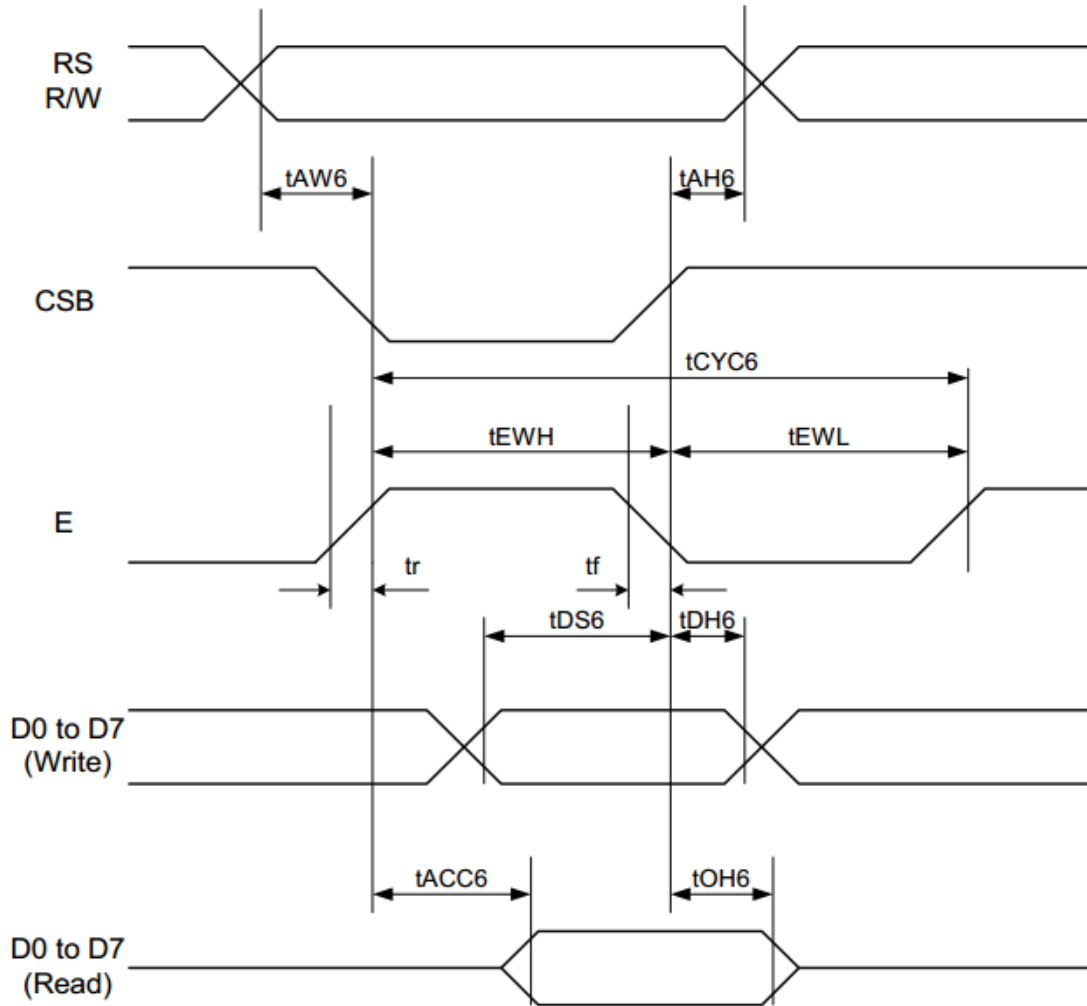
Instruction	Instruction Code										Description	Instruction Execution Time			
	RS	R/W	DB7	DB6	DB5	DB4	DB3	DB2	DB1	DB0		OSC=380KHz	OSC=540kHz	OSC=700KHz	
Clear Display	0	0	0	0	0	0	0	0	0	1	Write "20H" to DDRAM. and set DDRAM address to "00H" from AC	1.08 ms	0.76 ms	0.59 ms	
Return Home	0	0	0	0	0	0	0	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.	1.08 ms	0.76 ms	0.59 ms
Entry Mode Set	0	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.	26.3 us	18.5 us	14.3 us
Display ON/OFF	0	0	0	0	0	0	0	1	D	C	B	D=1:entire display on C=1:cursor on B=1:cursor position on	26.3 us	18.5 us	14.3 us
Function Set	0	0	0	0	1	DL	N	DH	*0	IS	DL: interface data is 8/4 bits N: number of line is 2/1 DH: double height font IS: instruction table select	26.3 us	18.5 us	14.3 us	
Set DDRAM address	0	0	1	AC6	AC5	AC4	AC3	AC2	AC1	AC0	Set DDRAM address in address counter	26.3 us	18.5 us	14.3 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	0	0	
Write data to RAM	1	0	D7	D6	D5	D4	D3	D2	D1	D0	Write data into internal RAM (DDRAM/CGRAM/ICONRAM)	26.3 us	18.5 us	14.3 us	
Read data from RAM	1	1	D7	D6	D5	D4	D3	D2	D1	D0	Read data from internal RAM (DDRAM/CGRAM/ICONRAM)	26.3 us	18.5 us	14.3 us	

Note *: this bit is for test command , and must always set to "0"

Instruction table 0 (IS=0)														
Cursor or Display Shift	0	0	0	0	0	1	S/C	R/L	x	x	S/C and R/L: Set cursor moving and display shift control bit, and the direction, without changing DDRAM data.	26.3 us	18.5 us	14.3 us
Set CGRAM	0	0	0	1	AC5	AC4	AC3	AC2	AC1	AC0	Set CGRAM address in address counter	26.3 us	18.5 us	14.3 us

Instruction table 1 (IS=1)														
Internal OSC frequency	0	0	0	0	0	1	BS	F2	F1	F0	BS=1:1/4 bias BS=0:1/5 bias F2~0: adjust internal OSC frequency for FR frequency.	26.3 us	18.5 us	14.3 us
Set ICON address	0	0	0	1	0	0	AC3	AC2	AC1	AC0	Set ICON address in address counter.	26.3 us	18.5 us	14.3 us
Power/ICON control/Contrast set	0	0	0	1	0	1	Ion	Bon	C5	C4	Ion: ICON display on/off Bon: set booster circuit on/off C5,C4: Contrast set for internal follower mode.	26.3 us	18.5 us	14.3 us
Follower control	0	0	0	1	1	0	Fon	Rab2	Rab1	Rab0	Fon: set follower circuit on/off Rab2~0: select follower amplified ratio.	26.3 us	18.5 us	14.3 us
Contrast set	0	0	0	1	1	1	C3	C2	C1	C0	Contrast set for internal follower mode.	26.3 us	18.5 us	14.3 us

Timing Characteristics



($T_a = 25^\circ\text{C}$)

Item	Signal	Symbol	Condition	VDD=2.7 to 4.5V Rating		VDD=4.5 to 5.5V Rating		Units
				Min.	Max.	Min.	Max.	
Address hold time	RS	t_{AH6}	—	20	-	20	-	ns
Address setup time	RS	t_{AW6}	—	20	-	20	-	
System cycle time	RS	t_{CYC6}	—	400	-	280	-	ns
Data setup time	D0 to D7	t_{DS6}	—	100	-	80	-	ns
Data hold time	D0 to D7	t_{DH6}		40	-	20	-	
Access time	D0 to D7	t_{ACC6}	CL = 100 pF	-	500	-	400	ns
Output disable time	D0 to D7	t_{OH6}		300	-	150	-	
Enable Rise/Fall time	E	t_r, t_f	—	-	20	-	20	ns
Enable H pulse time	E	t_{EWH}	—	200	-	120	-	ns
Enable L pulse time	E	t_{EWL}	—	150	-	130	-	ns

Note: All timing is specified using 20% and 80% of VDD as the reference.

Built-in Font Table

ST7032-0D (ITO option OPR1=1, OPR2=1)

b7-b4 b3-b0	0000	0001	0010	0011	0100	0101	0110	0111	1000	1001	1010	1011	1100	1101	1110	1111
0000	!	@	#	\$	%	&	'	()	*	+	,	-	.	/	:
0001	;	<	=	>	?	@	A	B	C	D	E	F	G	H	I	J
0010	K	L	M	N	O	P	Q	R	S	T	U	V	W	X	Y	Z
0011	[	\	\]	^	_	`	a	b	c	d	e	f	g	h	i	j
0100	k	l	m	n	o	p	q	r	s	t	u	v	w	x	y	z
0101	{	|	}	~	`	a	b	c	d	e	f	g	h	i	j	k
0110	l	m	n	o	p	q	r	s	t	u	v	w	x	y	z	{
0111	|	}	~	`	a	b	c	d	e	f	g	h	i	j	k	l
1000	m	n	o	p	q	r	s	t	u	v	w	x	y	z	{	|
1001	}	~	`	a	b	c	d	e	f	g	h	i	j	k	l	m
1010	n	o	p	q	r	s	t	u	v	w	x	y	z	{	|	}
1011	o	p	q	r	s	t	u	v	w	x	y	z	{	|	}	~
1100	p	q	r	s	t	u	v	w	x	y	z	{	|	}	~	`
1101	q	r	s	t	u	v	w	x	y	z	{	|	}	~	`	a
1110	r	s	t	u	v	w	x	y	z	{	|	}	~	`	a	b
1111	s	t	u	v	w	x	y	z	{	|	}	~	`	a	b	c

Example Initialization Program

```

/*****
/*****
void init()                //initialize the LCD
{

P3 = 1;
P1 = 1;
RST = 0;                    //RESET
delay(2);
RST = 1;                    //end reset
delay(20);
Writecom(0x30);            //wake up
delay(2);
Call writecom(0x30);       //wake up
Call writecom(0x30);       //wake up
Call writecom(0x39);       //function set
Call writecom(0x14);       //internal osc frequency
Call writecom(0x56);       //power control
Call writecom(0x6D);       //follower control

Call writecom(0x70);       //contrast
Call writecom(0x0C);       //display on
Call writecom(0x06);       //entry mode
Call writecom(0x01);       //clear
delay(10);
}
/*****
void writecom(int c)
{
RW = 0;                    //Write
RS = 0;                    //Command
E = 1;
P1 = c;
E = 0;
}
/*****
void writedata(int d)
{
RW = 0;                    //Write
RS = 1;                    //Data
E = 1;
P1 = d;
E = 0;
}
/*****
/*****

```

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 , 240hrs	2
Low Temperature storage	Endurance test applying the low storage temperature for a long time.	-30°C , 240hrs	1,2
High Temperature Operation	Endurance test applying the electric stress (voltage & current) and the high thermal stress for a long time.	+70°C , 240hrs	2
Low Temperature Operation	Endurance test applying the electric stress (voltage & current) and the low thermal stress for a long time.	-20°C , 240hrs	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 , 240hrs	1,2
Thermal Shock resistance	Endurance test applying the electric stress (voltage & current) during a cycle of low and high thermal stress.	-20°C,30min -> 25°C,5min -> 70°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 10 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

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