NHD-C0220BiZ-FS(RGB)-FBW-3VM

COG (Chip-On-Glass) Character Liquid Crystal Display Module

NHD-	Newhaven Display
C0220-	COG, 2 Lines x 20 Characters
BiZ-	Model, I^2C Interface
F-	Transflective
S(RGB)-	Side LED Backlights – Red, Green, and Blue
F-	FSTN, Positive
B-	6:00 Optimal View
W-	Wide Temperature
3V-	3.3V LCD
M-	Mounting Holes
	RoHS Compliant

Newhaven Display International, Inc.

2511 Technology Drive, Suite 101
Elgin IL, 60124
Ph: 847-844-8795 Fax: 847-844-8796

www.newhavendisplay.com
nhtech@newhavendisplay.com nhsales@newhavendisplay.com

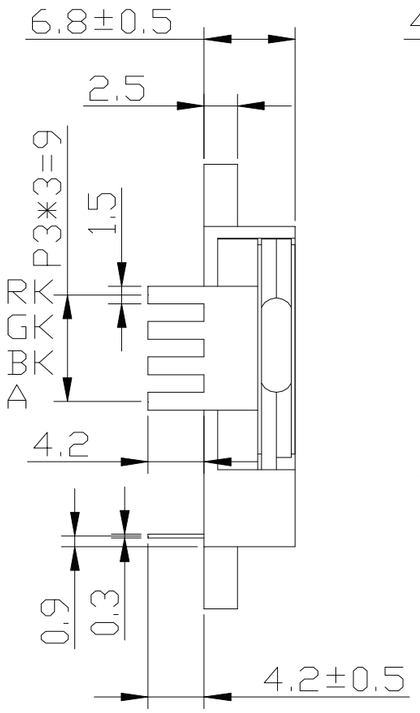
Document Revision History

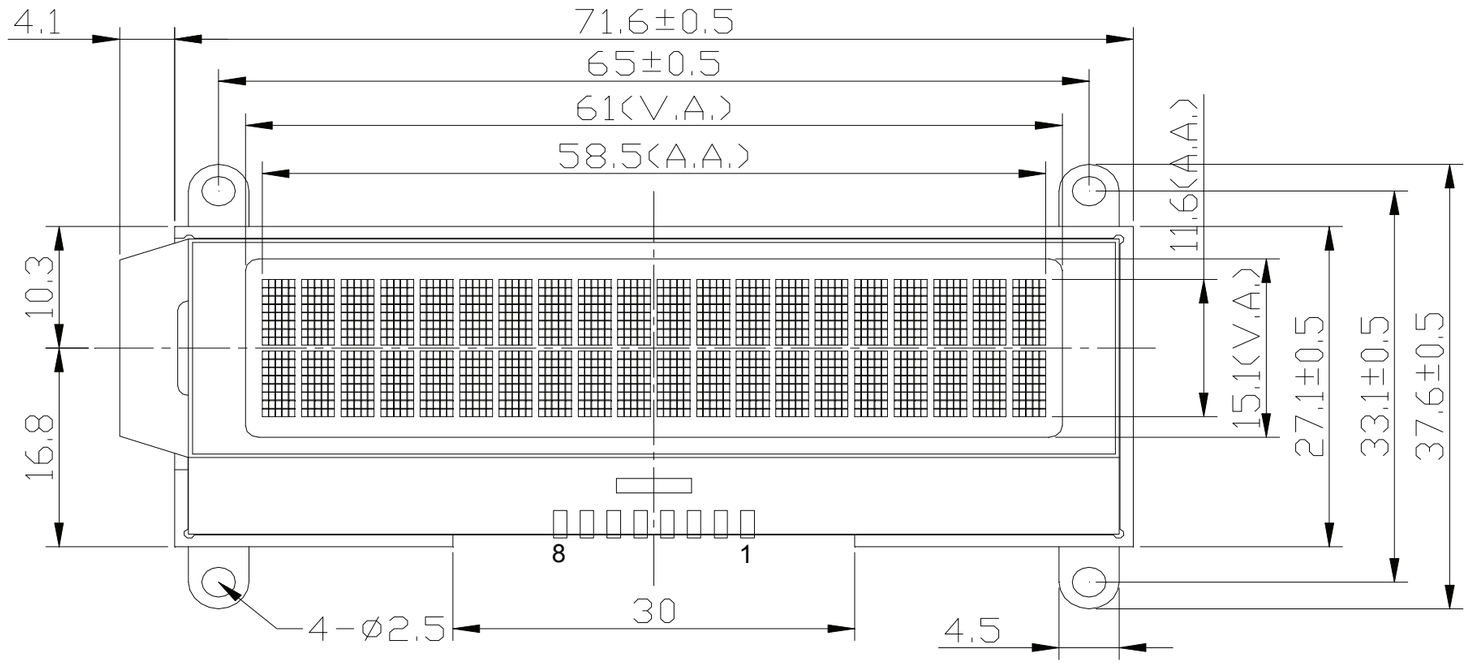
Revision	Date	Description	Changed by
0	7/8/09	Initial Release	CL
1	7/10/09	Mechanical Drawing updated	BE
2	9/8/09	Backlight supply current	BE
3	10/9/09	Updated Electrical Characteristics	MC
4	12/9/09	Updated Backlight Power supply and Current	MC
5	5/27/11	Display character address code updated	AK
6	6/13/11	Electrical characteristics updated	AK
7	6/23/14	Mechanical, Electrical & Optical Characteristics Updated	ML
8	5/24/17	Mechanical, Electrical Characteristics Updated	SB
9	3/20/18	Mechanical Drawing Updated	SB

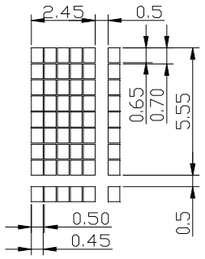
Functions and Features

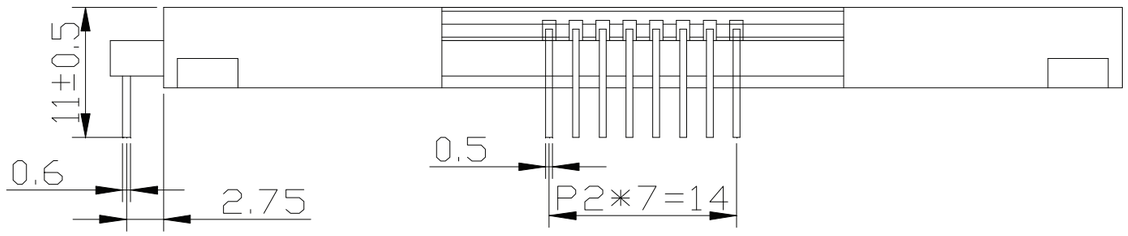
- **2 lines x 20 characters**
- **Built-in ST7036i controller with I^2C interface**
- **3.3V power supply**
- **1/16 duty, 1/5 bias**
- **Built-in DC supply for VLCD (requires 2 external capacitors)**

SYMBOL	REVISION	DATE



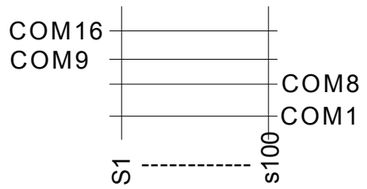






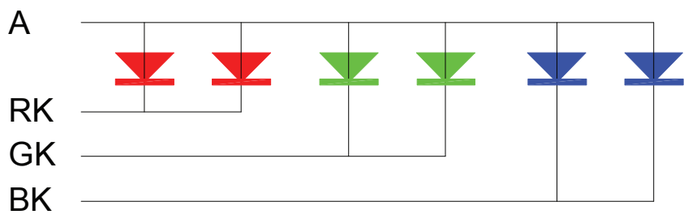
Pin Assignment

NO	SYMBOL
1	RST
2	SCL
3	SDA
4	VSS
5	VDD
6	VOUT
7	C1+
8	C1-



Notes:

1. Driver:	1/16 Duty, 1/5 Bias
2. Voltage:	3.3V VDD, 5.5V VLCD
3. Display Mode:	FSTN Positive / Transflective
4. Optimal View:	6:00
5. Backlight:	RGB LEDs
6. Driver IC:	ST7036i IIC Interface



STANDARD TOLERANCES (UNLESS OTHERWISE SPECIFIED)
LINEAR:
XX. ±0.3 mm
XX.X ±0.3 mm
XX.XX ±0.3 mm

UNLESS OTHERWISE SPECIFIED
- DIMENSIONS ARE IN MILLIMETERS
- THIRD ANGLE PROJECTION

NEWHAVEN DISPLAY INTERNATIONAL

DRAWING/PART NUMBER: NHD-C0220BiZ-FS(RGB)-FBW-3VM			REVISION: 1.0
			SIZE: A3
DRAWN BY: S. Baxi	CHECKED BY: S. Baxi	APPROVED BY: T. Tung	SCALE: NS
DRAWN DATE: 03/20/18	CHECKED DATE: 03/20/18	APPROVED DATE: 03/20/18	
DO NOT SCALE DRAWING		SHEET 1 OF 1	

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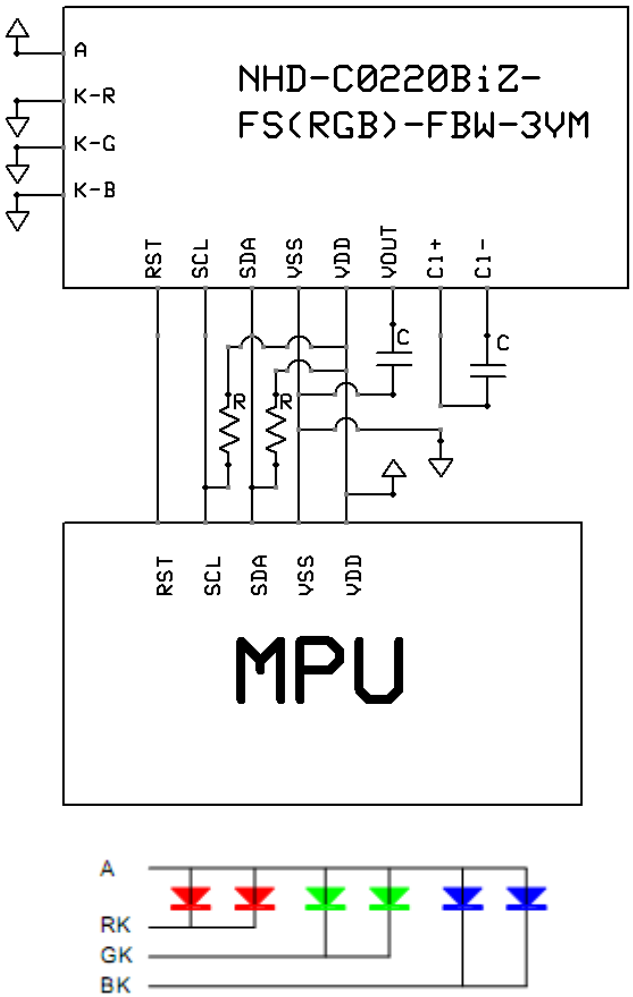
Pin Description and Wiring Diagram

Pin No.	Symbol	External Connection	Function Description
1	RST	MPU	Active LOW Reset signal
2	SCL	MPU	Serial Clock signal (requires pull-up resistor)
3	SDA	MPU	Serial Data signal (requires pull-up resistor)
4	V_{SS}	Power Supply	Ground
5	V_{DD}	Power Supply	Supply Voltage for Logic (+3.3V)
6	V_{OUT}	CAP	Connect 1µF cap to VSS or VDD
7	C1+	CAP	Connect 0.47-2.2µF cap to PIN8
8	C1-	CAP	Connect 0.47-2.2µF cap to PIN7

Recommended LCD connector: N/A, solder directly into PCB
Backlight connector: 3.0mm pitch pins, solder directly into PCB **Mates with**: ---



Capacitance 0.47µF~2.2µF; Recommended value = 1µF
Recommended Resistor: 10kΩ

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}	-	3.0	3.3	3.6	V
Supply Current	I_{DD}	V_{DD} = 3.3V	0.2	0.5	1.5	mA
Supply for LCD (contrast)	V_{LCD}	T_{OP} = 25°C	5.3	5.5	5.7	V
"H" Level input	V_{IH}	-	0.7 * V_{DD}	-	V_{DD}	V
"L" Level input	V_{IL}	-	V_{SS}	-	0.8	V
"H" Level output	V_{OH}	-	0.7 * V_{DD}	-	V_{DD}	V
"L" Level output	V_{OL}	-	V_{SS}	-	0.8	V
Backlight Supply Current – RED	I_R	-	-	20	30	mA
Backlight Supply Voltage – RED	V_R	I_R = 20mA	1.7	1.9	2.1	V
Backlight Supply Current – GREEN	I_G	-	-	30	40	mA
Backlight Supply Voltage – GREEN	V_G	I_G = 30mA	2.7	2.9	3.1	V
Backlight Supply Current – BLUE	I_B	-	-	30	40	mA
Backlight Supply Voltage – BLUE	V_B	I_B = 30mA	2.7	2.9	3.1	V

*The LED of the backlight is driven by current; 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	-	40	-	°
	Bottom	φY-		-	60	-	°
	Left	θX-		-	60	-	°
	Right	θX+		-	60	-	°
Contrast Ratio		CR	-	2	5	-	-
Response Time	Rise	T_R	T_{OP} = 25°C	-	150	250	ms
	Fall	T_F		-	200	300	ms

Controller Information

Built-in ST7036i controller.

Please download specification at http://www.newhavendisplay.com/app_notes/ST7036.pdf

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

Slave Address = 0x78

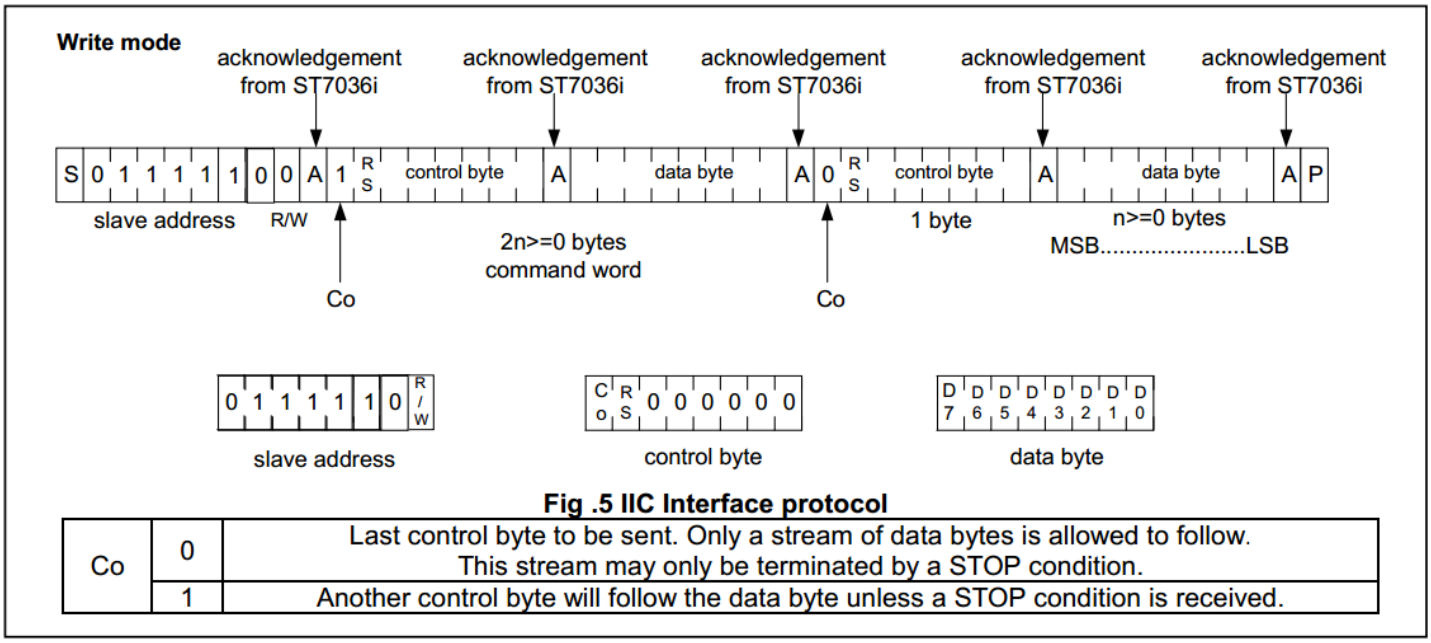


Fig .5 IIC Interface protocol

Co	0	Last control byte to be sent. Only a stream of data bytes is allowed to follow. This stream may only be terminated by a STOP condition.
	1	Another control byte will follow the data byte unless a STOP condition is received.

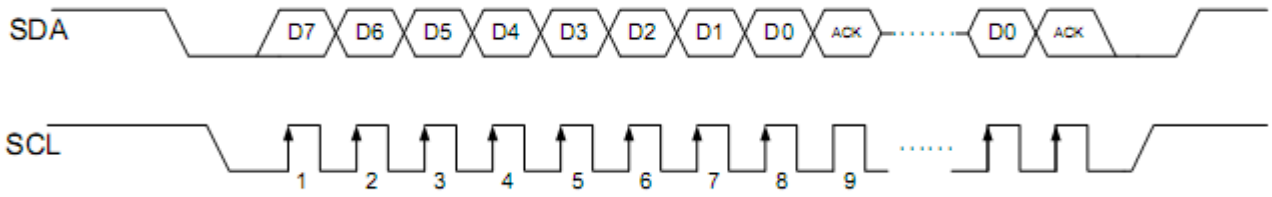


Table of Commands

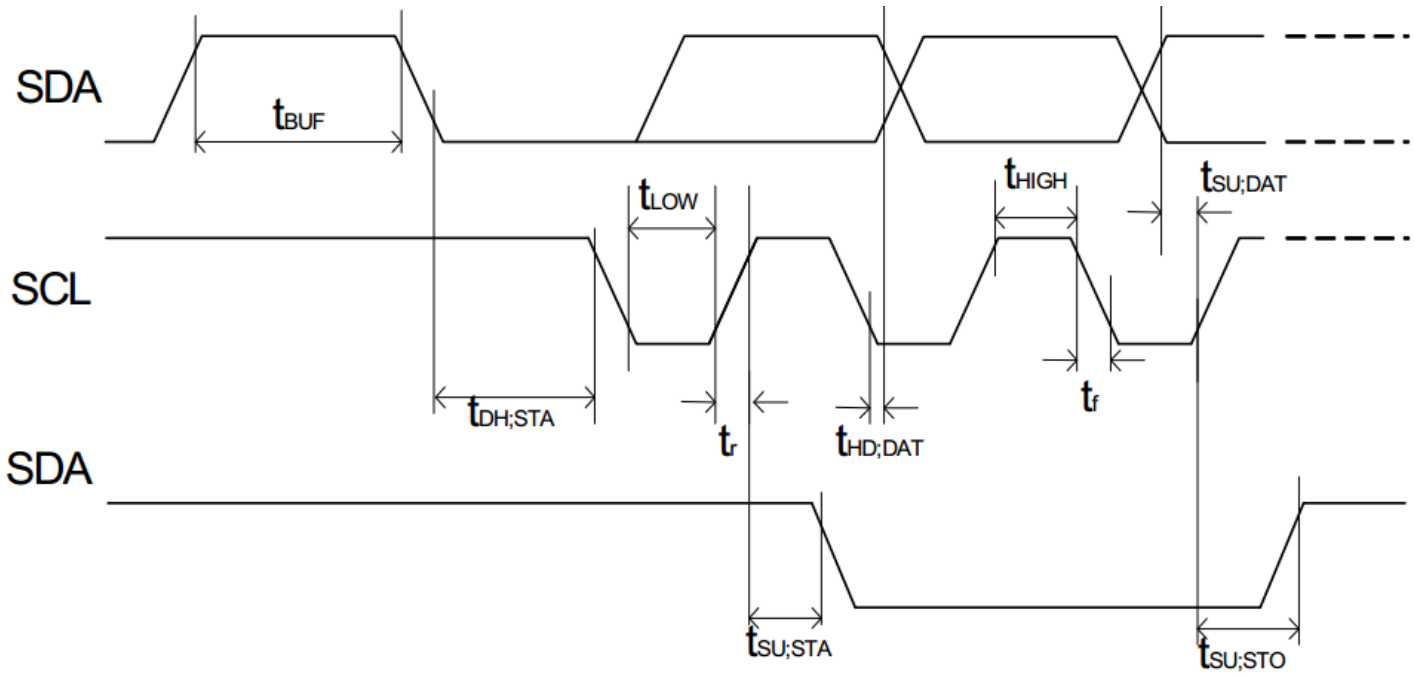
Instruction	Instruction Code										Description
	RS	R/W	DB7	DB6	DB5	DB4	DB3	DB2	DB1	DB0	
Clear Display	0	0	0	0	0	0	0	0	0	1	Write "20H" to DDRAM. and set DDRAM address to "00H" from AC
Return Home	0	0	0	0	0	0	0	0	1	x	Set DDRAM address to "00H" from AC and return cursor to its original position if shifted. The contents of DDRAM are not changed.
Entry Mode Set	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.
Display ON/OFF	0	0	0	0	0	0	1	D	C	B	D=1:entire display on C=1:cursor on B=1:cursor position on
Function Set	0	0	0	0	1	DL	N	DH	IS2	IS1	DL: interface data is 8/4 bits N: number of line is 2/1 DH: double height font IS[2:1]: instruction table select
Set DDRAM Address	0	0	1	AC6	AC5	AC4	AC3	AC2	AC1	AC0	Set DDRAM address in address counter
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.
Write Data to RAM	1	0	D7	D6	D5	D4	D3	D2	D1	D0	Write data into internal RAM (DDRAM/CGRAM/ICONRAM)
Read Data from RAM	1	1	D7	D6	D5	D4	D3	D2	D1	D0	Read data from internal RAM (DDRAM/CGRAM/ICONRAM)

Instruction table 0(IS[2:1]=[0,0])											
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.
Set CGRAM	0	0	0	1	AC5	AC4	AC3	AC2	AC1	AC0	Set CGRAM address in address counter

Instruction table 1(IS[2:1]=[0,1])											
Bias Set	0	0	0	0	0	1	BS	1	0	FX	BS=1:1/4 bias BS=0:1/5 bias FX: fixed on high in 3-line application and fixed on low in other applications.
Set ICON Address	0	0	0	1	0	0	AC3	AC2	AC1	AC0	Set ICON address in address counter.
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.
Follower Control	0	0	0	1	1	0	Fon	Rab 2	Rab 1	Rab 0	Fon: set follower circuit on/off Rab2~0: select follower amplified ratio.
Contrast Set	0	0	0	1	1	1	C3	C2	C1	C0	Contrast set for internal follower mode.

Instruction table 2(IS[2:1]=[1,0])											
Double Height Position Select	0	0	0	0	0	1	UD	X	x	x	UD: Double height position select
Reserved	0	0	0	1	X	X	X	X	X	X	Do not use (reserved for test)

Timing Characteristics



Item	Signal	Symbol	Condition	VDD=2.7 to 4.5V Rating		VDD=4.5 to 5.5V Rating		Units
				Min.	Max.	Min.	Max.	
SCL clock frequency	SCL	f_{SCLK}	—	DC	300K	DC	400	kHz
SCL clock low period		t_{LOW}		2.5	—	1.3	—	μs
SCL clock high period		t_{HIGH}		0.6	—	0.6	—	
Data set-up time	SDA	$t_{SU;DAT}$	—	1800	—	700	—	ns
Data hold time		$t_{HD:DAT}$		0	—	0	0.5	μs
SCL,SDA rise time	SCL, SDA	t_r	—	20+0.1C_b	300	20+0.1C_b	300	ns
SCL,SDA fall time		t_f		20+0.1C_b	300	20+0.1C_b	300	
Capacitive load represent by each bus line		C_b	—	—	400	—	400	pf
Setup time for a repeated START condition	SDA	$t_{SU;STA}$	—	0.6	—	0.6	—	μs
Start condition hold time		$t_{HD;STA}$	—	1.8	—	1.0	—	μs
Setup time for STOP condition		$t_{SU;STO}$	—	0.6	—	0.6	—	μs
Bus free time between a Stop and START condition	SCL	t_{BUF}	—	1.3	—	1.3	—	μs

Built-in Font Table (OPR1 = 0, OPR2 = 0)

Example Initialization Program

```
/*****************************************************
*           Initialization For ST7036i               *
*****************************************************/
void init_LCD()
{
I2C_Start();
I2C_out(Slave);//Slave=0x78
I2C_out(Comsend);//Comsend = 0x00
I2C_out(0x38);
delay(10);
I2C_out(0x39);
delay(10);
I2C_out(0x14);
I2C_out(0x78);
I2C_out(0x5E);
I2C_out(0x6D);
I2C_out(0x0C);
I2C_out(0x01);
I2C_out(0x06);
delay(10);
I2C_Stop();
}
/*****************************************************/


/*****************************************************
*           Output command or data via I2C           *
*****************************************************/
void I2C_out(unsigned char j)                 //I2C Output
{
        int n;
        unsigned char d;
        d=j;
        for(n=0;n<8;n++){
                if((d&0x80)==0x80)
                SDA=1;
                else
                SDA=0;
                d=(d<<1);
                SCL = 0;
                SCL = 1;
                SCL = 0;
                }
        SCL = 1;
        while(SDA==1){
                SCL=0;
                SCL=1;
                }
        SCL=0;
}
/*****************************************************/
```

```
/*****************************************************
*           I2C Start                                *
*****************************************************/
void I2C_Start(void)
{
        SCL=1;
        SDA=1;
        SDA=0;
        SCL=0;
}
/*****************************************************/

/*****************************************************
*           I2C Stop                                 *
*****************************************************/
void I2C_Stop(void)
{
        SDA=0;
        SCL=0;
        SCL=1;
        SDA=1;
}
/*****************************************************/

/*****************************************************
*           Send string of ASCII data to LCD         *
*****************************************************/
void Show(unsigned char *text)
{
        int n,d;
        d=0x00;
        I2C_Start();
        I2C_out(Slave); //Slave=0x78
        I2C_out(Datasend);//Datasend=0x40
        for(n=0;n<20;n++){
                I2C_out(*text);
                ++text;
                }
        I2C_Stop();
}
/*****************************************************/
/*****************************************************/
/*****************************************************/
```

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 , 96hrs	2
Low Temperature storage	Endurance test applying the low storage temperature for a long time.	-30°C , 96hrs	1,2
High Temperature Operation	Endurance test applying the electric stress (voltage & current) and the high thermal stress for a long time.	+70°C , 96hrs	2
Low Temperature Operation	Endurance test applying the electric stress (voltage & current) and the low thermal stress for a long time.	-20°C , 96hrs	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.	+60°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.	-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 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

See Terms & Conditions at http://www.newhavendisplay.com/index.php?main_page=terms