

**Product Specification**

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# NHD-1.8-128160EF-SSXN-F

## TFT (Thin-Film Transistor) Liquid Crystal Display Module

<b>NHD-</b>	Newhaven Display
<b>1.8-</b>	1.8" Diagonal Size
<b>128160-</b>	128 x 160 Pixels (Portrait Mode)
<b>EF-</b>	Model
<b>S-</b>	Built-in Controller, 3/4-Wire Serial Interface
<b>S-</b>	Sunlight Readable
<b>X-</b>	TFT
<b>N-</b>	TN, 6:00 Optimal View, Wide Temperature
<b>F-</b>	FFC ZIF Connection Style

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## Additional Resources

- **Support Forum:** <https://support.newhavendisplay.com/hc/en-us/community/topics>
- **GitHub:** <https://github.com/newhavendisplay>
- **Example Code:** <https://support.newhavendisplay.com/hc/en-us/categories/4409527834135-Example-Code/>
- **Knowledge Center:** [https://www.newhavendisplay.com/knowledge\\_center.html](https://www.newhavendisplay.com/knowledge_center.html)
- **Quality Center:** [https://www.newhavendisplay.com/quality\\_center.html](https://www.newhavendisplay.com/quality_center.html)
- **Precautions for using LCDs/LCMs:** <https://www.newhavendisplay.com/specs/precautions.pdf>
- **Warranty / Terms & Conditions:** <https://www.newhavendisplay.com/terms.html>



## Document Revision History

Revision	Date	Description	Changed By
-	02/27/2019	Initial Release	AS
1	06/10/2019	Added MPU Interface Summary & Pinout Details	AS
2	10/31/2019	Adjusted Viewing Angles	SB
3	02/26/2020	FPC Redesign: Pin 12 changed from NC to TE P/N updated to Rev1B	SM
4	08/19/2020	Updated Optical Characteristics & Quality Information	AS
5	03/09/2021	Updated Silkscreen on FPC & Quality Information	AS
6	08/07/2023	Timing Characteristics, Wiring Diagram, and Table of Commands Updated	KL
7	09/05/2023	V <sub>DD</sub> /IOV <sub>DD</sub> Supply Voltage Updated from 2.8V to 3.0V (Typ.) Mechanical Drawing Updated	KL
8	03/07/2024	Date Code Format Updated on Mechanical Drawing	KL

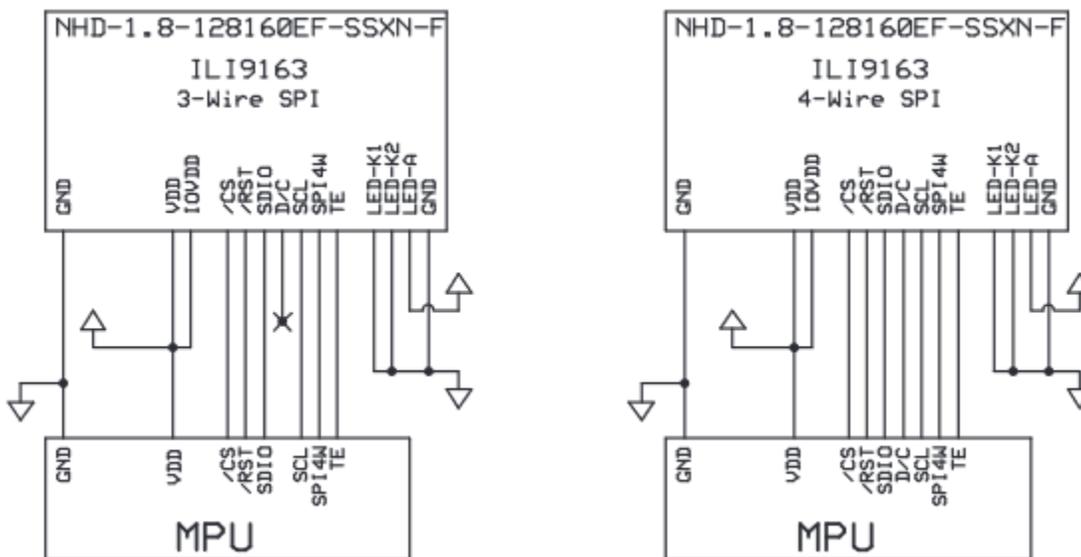


## Pin Description

Pin No.	Symbol	External Connection	Function Description
1	GND	Power Supply	Ground
2	IOVDD	Power Supply	Supply Voltage for Logic (3.0V) – Can be tied to VDD
3	VDD	Power Supply	Supply Voltage for LCD (3.0V)
4	/CS	MPU	Active LOW Chip Select signal
5	/RST	MPU	Active LOW Reset signal
6	SDIO	MPU	Serial Data Input & Output signal
7	GND	Power Supply	Ground
8	D/C	MPU	Data / Command selection 4-wire Serial: '1' = Data ; '0' = Command 3-wire Serial: Ground
9	SCL	MPU	Serial Clock signal
10	GND	Power Supply	Ground
11	SPI4W	MPU	SPI4W: '1' = 4-wire SPI ; '0' = 3-wire SPI (default)
12	TE	MPU	Tearing Effect output pin to synchronize MCU to frame writing. If not used, leave this pin floating (No Connect)
13-16	NC	-	No Connect
17	LED-A	Power Supply	Backlight Anode (100mA @ 3.2V)
18	LED-K1	Power Supply	Backlight Cathode
19	LED-K2	Power Supply	Backlight Cathode
20	GND	Power Supply	Ground
21-24	NC	-	No Connect

Recommended LCD connector: 24pin 0.5mm FFC connector. Molex P/N: 52435-2471

## Wiring Diagram



## Interface Selection

### MPU Interface Pin Assignment Summary

	Pin 4 (/CS)	Pin 6 (SDIO)	Pin 8 (D/C)	Pin 9 (SCL)	Pin 11 (SPI4W)
<b>3-wire SPI (default)</b>	Chip Select	Serial Data I/O	Tie LOW	Serial Clock	0
<b>4-wire SPI</b>	Chip Select	Serial Data I/O	Data/Command	Serial Clock	1

## 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 for LCD	V <sub>DD</sub>	-	2.5	3.0	3.3	V
Supply Voltage for Logic	IOV <sub>DD</sub>	-	1.65	3.0	3.3	V
Supply Current	I <sub>DD</sub>	V <sub>DD</sub> = 3.0V	1	3	5	mA
"H" Level input	V <sub>IH</sub>	-	0.7*IOV <sub>DD</sub>	-	IOV <sub>DD</sub>	V
"L" Level input	V <sub>IL</sub>	-	GND	-	0.3*IOV <sub>DD</sub>	V
"H" Level output	V <sub>OH</sub>	-	0.8*IOV <sub>DD</sub>	-	IOV <sub>DD</sub>	V
"L" Level output	V <sub>OL</sub>	-	GND	-	0.2*IOV <sub>DD</sub>	V
Backlight Supply Current	I <sub>LED</sub>	-	-	100	125	mA
Backlight Supply Voltage	V <sub>LED</sub>	I <sub>LED</sub> = 100mA	2.8	3.2	3.4	V
Backlight Lifetime*	-	I <sub>LED</sub> = 100mA T <sub>OP</sub> = 25°C	20,000	30,000	-	Hrs.

\*Backlight lifetime is rated as Hours until **half-brightness**, under normal operating conditions. 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 ≥ 10	-	60	-	°	
	Bottom		-	40	-	°	
	Left		-	60	-	°	
	Right		-	60	-	°	
Contrast Ratio	CR	-	400	500	-	-	
Luminance	L <sub>V</sub>	I <sub>LED</sub> =100mA	880	1100	-	cd/m <sup>2</sup>	
Response Time	Rise + Fall	T <sub>R</sub> +T <sub>F</sub>	T <sub>OP</sub> = 25°C	-	8	16	ms
Chromaticity	Red	X <sub>R</sub>	-	0.552	0.602	0.652	
		Y <sub>R</sub>		0.321	0.371	0.421	
	Green	X <sub>G</sub>		0.266	0.316	0.366	
		Y <sub>G</sub>		0.542	0.592	0.642	
	Blue	X <sub>B</sub>		0.088	0.138	0.188	
		Y <sub>B</sub>		0.049	0.099	0.149	
	White	X <sub>W</sub>		0.245	0.295	0.345	
		Y <sub>W</sub>		0.288	0.338	0.388	

## Controller Information

Built-in ILI9163V Controller: <https://support.newhavendisplay.com/hc/en-us/articles/4414575853079--ILI9163V>



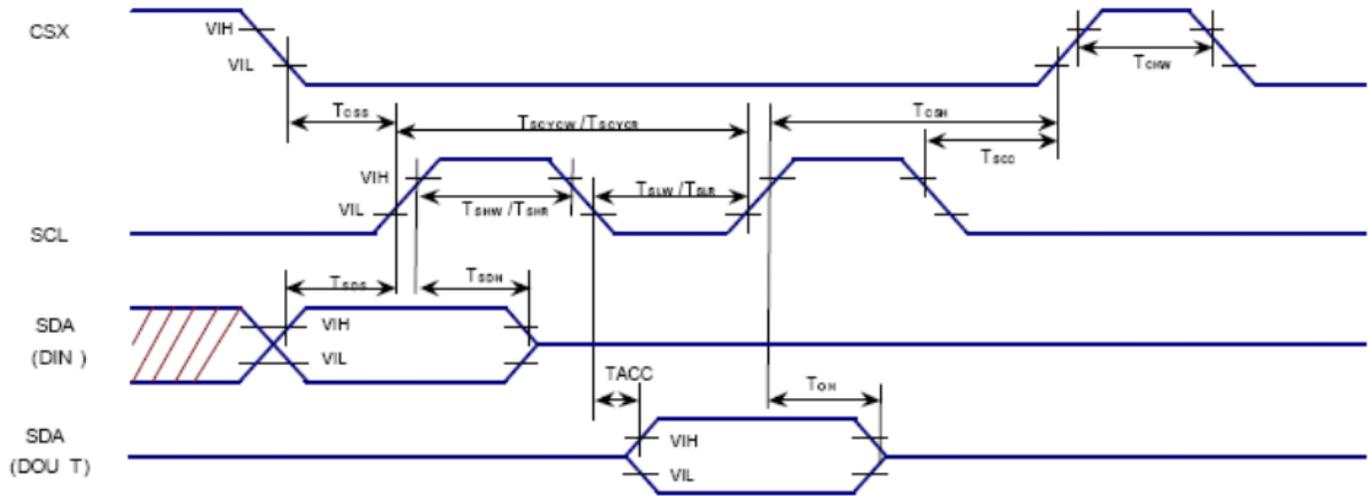
## Table of commands

For Command Table and Descriptions, please see:

[https://support.newhavendisplay.com/hc/en-us/article\\_attachments/4414532035607/ILI9163V.pdf](https://support.newhavendisplay.com/hc/en-us/article_attachments/4414532035607/ILI9163V.pdf)

## Timing Characteristics

### 3-wire Serial Interface:



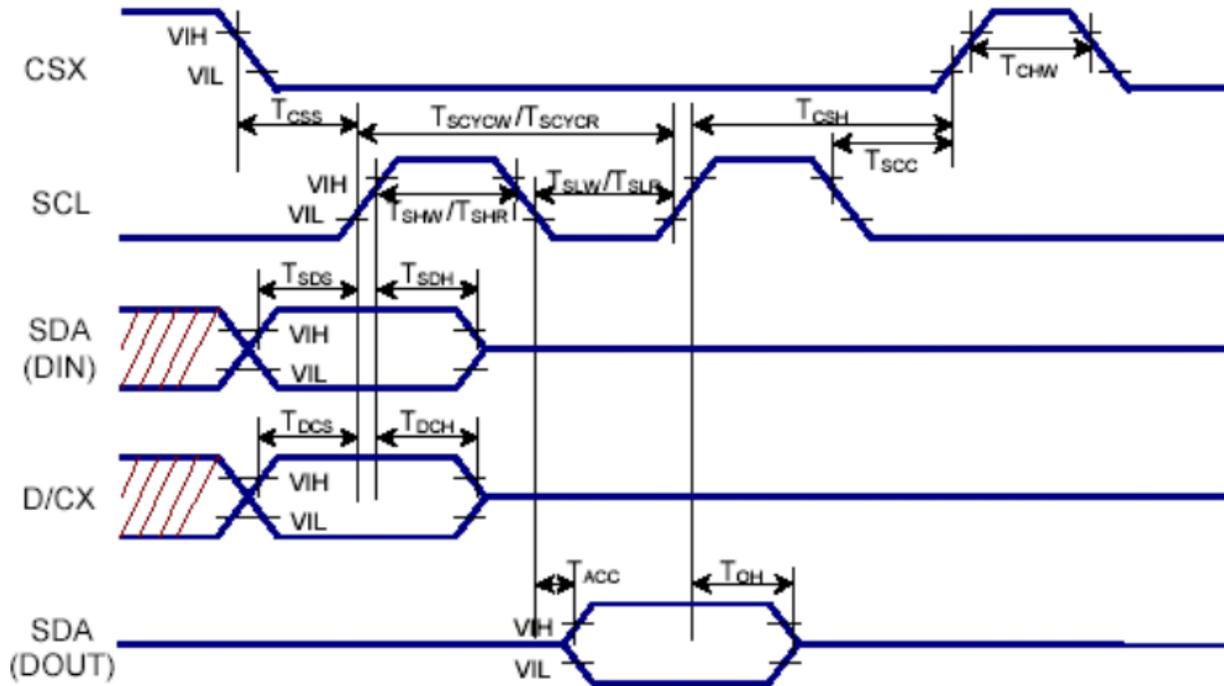
Signal	Symbol	Parameter	MIN	MAX	Unit	Description
CSX	TCSS	Chip select setup time	10		ns	
	TCSH	Chip select hold time	30		ns	
	TCHW	Chip select "H" pulse width	30		ns	
SCL	TSCYCW	Serial clock cycle(Write)	66		ns	
	TSHW	S"L" to "H" pulse width(Write)	15		ns	
	TSLW	S"L" to "L" pulse width(Write)	15		ns	
	TSCYCR	Serial clock cycle(Read)	150		ns	
	TSHR	S"L" to "H" pulse width(Read)	60		ns	
	TSLR	S"L" to "L" pulse width(Read)	60		ns	
SDA(DIN) (DOU T)	TSDS	Data setup time	5		ns	
	TSDH	Data hold time	5		ns	
	TACC	Access time	5	50	ns	For maximum CL = 30pF
	TOH	Output disable time	10		ns	For minimum CL = 8pF

Note 1: VDDI=1.65 to 3.3V, VCI=2.6 to 3.3V, AGND=GND=0V. Ta=-30 to 70°C (to +85°C no damage)

Note 2: The input signal rise time and fall time(tr, tf) is specified at 15 ns or less.

Logic high and low levels are specified as 10% and 90% of VDDI for Input signals.

### 4-wire Serial Interface



Signal	Symbol	Parameter	MIN	MAX	Unit	Description
CSX	T <sub>css</sub>	Chip select setup time	10		ns	
	T <sub>sch</sub>	Chip select hold time	30		ns	
	T <sub>chW</sub>	Chip select "H" pulse width	30		ns	
SCL	T <sub>scycw</sub>	Serial clock cycle(Write)	66		ns	
	T <sub>shw</sub>	S"L""H" pulse width(Write)	15		ns	
	T <sub>slw</sub>	S"L""L" pulse width(Write)	15		ns	
	T <sub>scyCR</sub>	Serial clock cycle(Read)	150		ns	
	T <sub>shr</sub>	S"L""H" pulse width(Read)	60		ns	
	T <sub>slr</sub>	S"L""L" pulse width(Read)	60		ns	
D/CX	T <sub>dcs</sub>	D/CX setup time	5		ns	
	T <sub>dch</sub>	D/CX hold time	5		ns	
SDA(DIN) (DOUT)	T <sub>sds</sub>	Data setup time	5		ns	
	T <sub>sdh</sub>	Data hold time	5		ns	
	T <sub>acc</sub>	Access time	5	50	ns	For maximum CL = 30pF
	T <sub>oh</sub>	Output disable time	10		ns	For minimum CL = 8pF

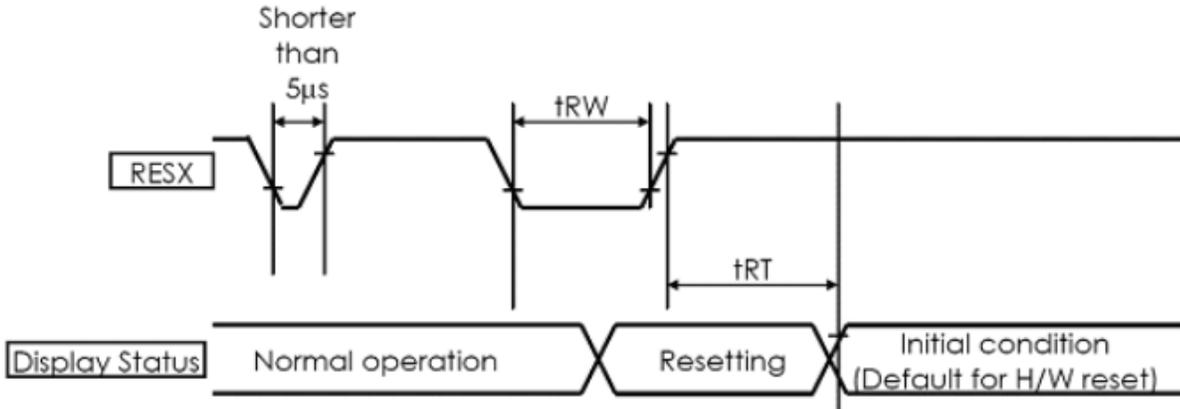
Note 1: VDDI=1.65 to 3.3V, VCI=2.6 to 3.3V, AGND=GND=0V. Ta=-30 to 70°C (to +85°C no damage)

Note 2 : The input signal rise time and fall time(tr, tf) is specified at 15 ns or less.

Logic high and low levels are specified as 10% and 90% of VDDI for Input signals.



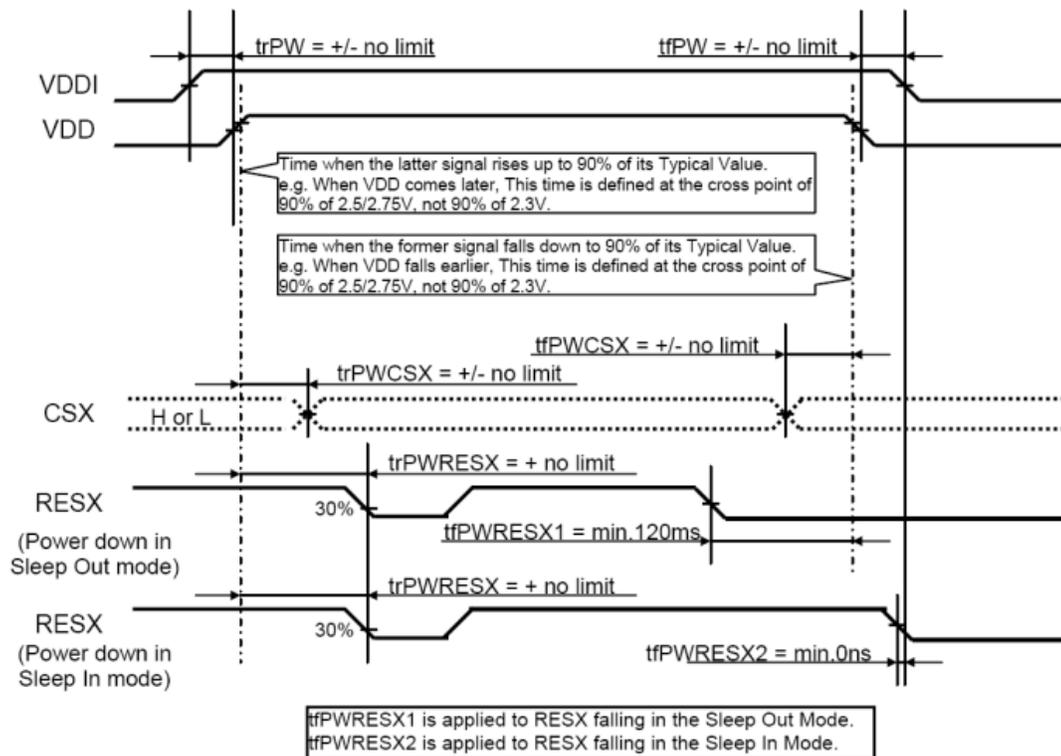
## Reset Timing



(VSS=0V, VDDI=1.65V to 1.95V, VCI=2.6V to 2.9V, Ta = -30 to 70°C)

Symbol	Parameter	Related Pins	MIN	TYP	MAX	Note	Unit
tRESW	*1) Reset low pulse width	RESX	10	-	-	-	μs
tREST	*2) Reset complete width	-	-	-	5	When reset applied during Sleep in mode	ms
		-	-	-	120	When reset applied during Sleep out mode	ms

## Power ON/OFF Sequence



Note: Unless otherwise specified, timings herein show cross point at 50% of signal/power level.

## Example Program Code

```

*****/
*      Initialization and Setup Routine for 3-Line & 4-Line      *
*****/

```

```

void setup()
{
  DDRB = 0xFF;           //Enable All outputs on PortB
  PORTB = 0x00;
  DDRD = 0xFF;           //Enable All outputs on PortD
  PORTD = 0x00;
  DDRD |= (1<<DDD6);     //SDIO = 1
  DDRD |= (1<<DDD7);     //SCL = 1
  digitalWrite(RST, LOW);
  delay(150);
  digitalWrite(RST, HIGH);
  delay(150);
  command(0x11);         //exit SLEEP mode
  delay(100);
  command(0x28);         //display off
  command(0x26);         //select gamma curve
  data(0x04);

  command(0xB1);         //frame rate control
  data(0x0A);
  data(0x14);

  command(0xC0);         //power control 1
  data(0x0A);
  data(0x00);

  command(0xC1);         //power control 2
  data(0x02);

  command(0xC5);         //VCOM control 1
  data(0x2F);
  data(0x3E);

  command(0xC7);         //VCOM control 2
  data(0x40);

  command(0x2A);         //column address set
  data(0x00);

  data(0x00);           //start 0x0000
  data(0x00);

  data(0x7F);           //end 0x007F
  command(0x2B);         //page address set
  data(0x00);
  data(0x00);           //start 0x0000
  data(0x00);
  data(0x9F);           //end 0x009F

  command(0x36);         //memory access control
  data(0xC0);           //C0 = RGB; C8 = BGR
  command(0x3A);         //pixel format = 18 bit per pixel
  data(0x06);

  command(0x29);         //display ON
  delay(10);
}

```



### 3-line Serial Interface

```

/*****
*           Functions           *
*****/

```

```

void command(unsigned char c) //9-bit Transmission
{
  digitalWrite(CS, LOW);          ///CS = 0
  PORTD &= ~(1<<PORTD6);         //SDIO = 0 (Set D/C bit LOW for Command)
  PORTD &= ~(1<<PORTD7);         //SCL = 0
  PORTD |= (1<<PORTD7);          //SCL = 1
  PORTD &= ~(1<<PORTD7);         //SCL = 0
  for (int i=0;i<8;i++)
  {
    if((c & 0x80)== 0x80)        //Send MSB
      PORTD |= (1<<PORTD6);      //SDIO = 1
    else
      PORTD &= ~(1<<PORTD6);     //SDIO = 0
    c = (c<<1);
    PORTD &= ~(1<<PORTD7);       //SCL = 0
    PORTD |= (1<<PORTD7);        //SCL = 1
    PORTD &= ~(1<<PORTD7);       //SCL = 0
  }
  digitalWrite(CS, HIGH);        ///CS = 1
}

```

---

```

void data(unsigned char d) //9-bit Transmission
{
  digitalWrite(CS, LOW);          ///CS = 0
  PORTD |= (1<<PORTD6);           //SDIO = 1 (Set D/C bit HIGH for Data)
  PORTD &= ~(1<<PORTD7);         //SCL = 0
  PORTD |= (1<<PORTD7);          //SCL = 1
  PORTD &= ~(1<<PORTD7);         //SCL = 0
  for (int i=0;i<8;i++)
  {
    if((d & 0x80)== 0x80)        //Send MSB
      PORTD |= (1<<PORTD6);      //SDIO = 1
    else
      PORTD &= ~(1<<PORTD6);     //SDIO = 0
    d = (d<<1);
    PORTD &= ~(1<<PORTD7);       //SCL = 0
    PORTD |= (1<<PORTD7);        //SCL = 1
    PORTD &= ~(1<<PORTD7);       //SCL = 0
  }
  digitalWrite(CS, HIGH);        ///CS = 1
}

```



## 4-line Serial Interface

```

/*****
*           Functions           *
*****/

```

```
void command(unsigned char c) //8-bit Transmission
```

```

{
digitalWrite(CS, LOW);           //CS = 0
digitalWrite(DC, LOW);           //D/C = 0
for (int i=0;i<8;i++)
{
if((c & 0x80)== 0x80)           //Send MSB
PORTD |= (1<<PORTD6);           //SDIO = 1
else
PORTD &= ~(1<<PORTD6);           //SDIO = 0
c = (c<<1);
PORTD &= ~(1<<PORTD7);           //SCL = 0
PORTD |= (1<<PORTD7);           //SCL = 1
PORTD &= ~(1<<PORTD7);           //SCL = 0
}
digitalWrite(CS, HIGH);           //CS = 1
}

```

---

```
void data(unsigned char d) //8-bit Transmission
```

```

{
digitalWrite(CS, LOW);           //CS = 0
digitalWrite(DC, HIGH);           //D/C = 1
for (int i=0;i<8;i++)
{
if((d & 0x80)== 0x80)           //Send MSB
PORTD |= (1<<PORTD6);           //SDIO = 1
else
PORTD &= ~(1<<PORTD6);           //SDIO = 0
d = (d<<1);
PORTD &= ~(1<<PORTD7);           //SCL = 0
PORTD |= (1<<PORTD7);           //SCL = 1
PORTD &= ~(1<<PORTD7);           //SCL = 0
}
digitalWrite(CS, HIGH);           //CS = 1
}

```

## 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 Storage	Endurance test applying the electric stress (voltage & current) and the high thermal with high humidity stress for a long time.	+50°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,60min -> 70°C,60min = 1 cycle, 20 cycles.	
Vibration test	Endurance test applying vibration to simulate transportation and use.	10-50Hz, 1.5G amplitude. 30min in each of 3 directions X, Y, Z	3
Static electricity test	Endurance test applying electric static discharge.	Air: ±8kV 150pF/330Ω, 5 Times	
		Contact: ±4kV 150pF/330Ω, 5 Times	

**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.