

Product Specification

NHD-2.4-240320AF-CSXP

TFT Liquid Crystal Display

NHD-	Newhaven Display
2.4-	2.4" Diagonal
240320-	240xRGBx320 Pixels
AF-	Model
C-	Built-in Controller
S-	High Brightness, White LED Backlight
X-	TFT
P-	IPS, Wide Temperature

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Additional Resources

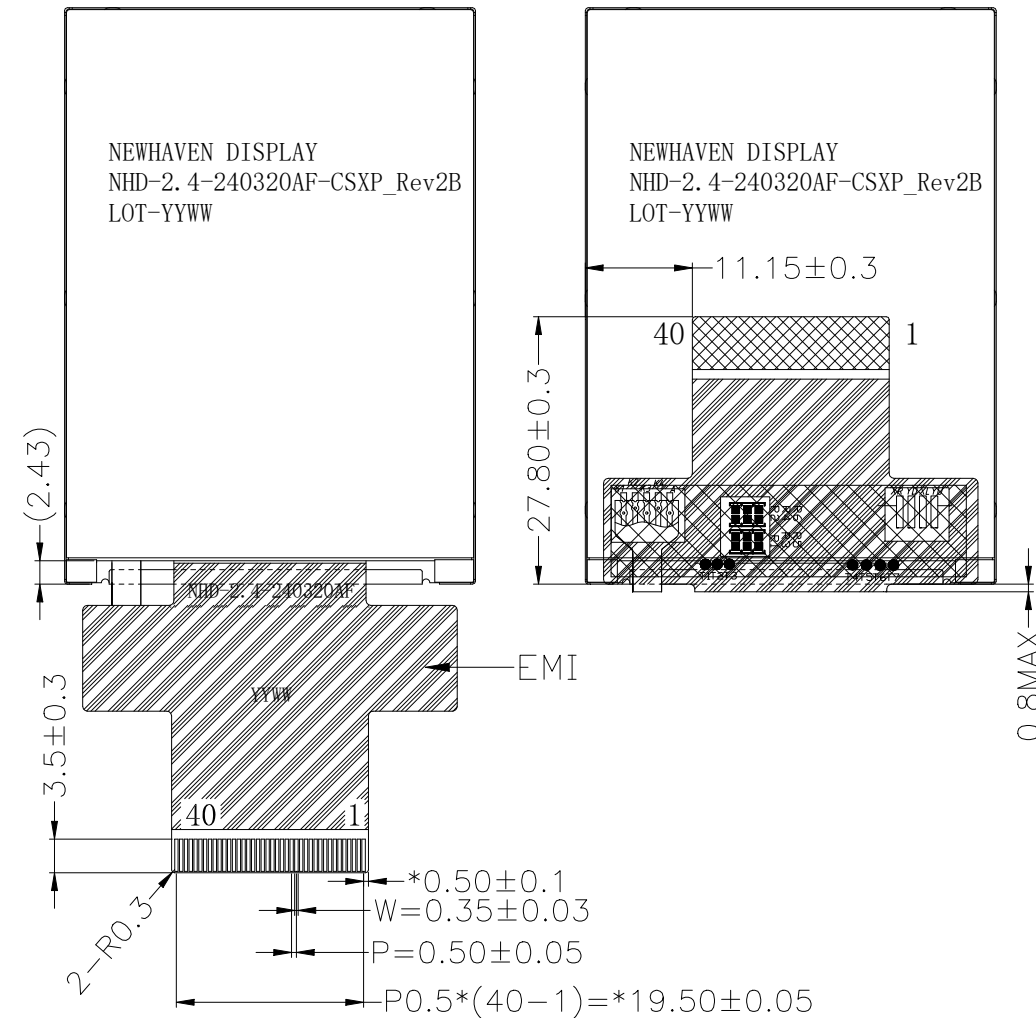
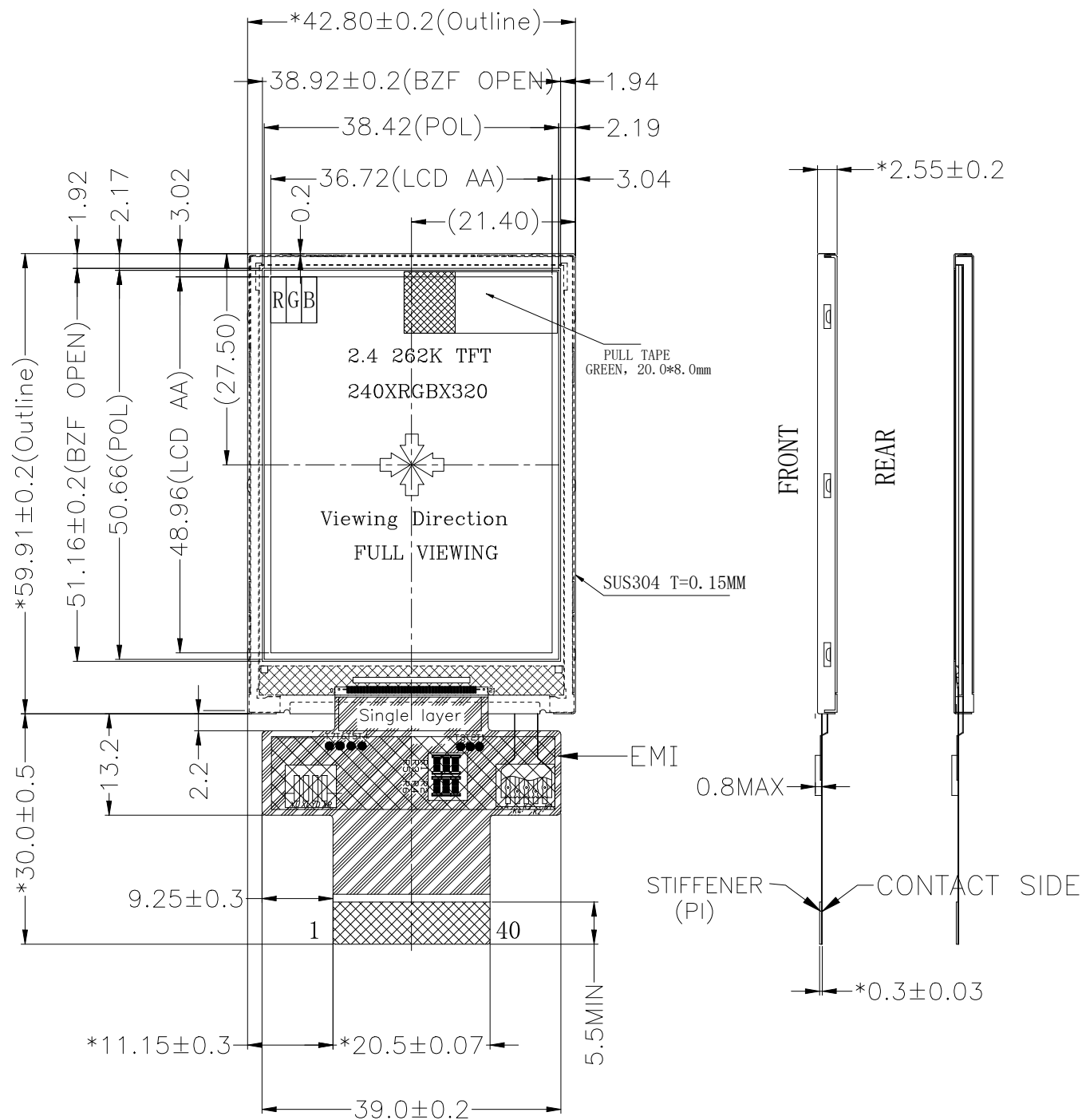
- **Support Forum:** <https://support.newhavendisplay.com/hc/en-us/community/topics>
- **GitHub:** <https://github.com/newhavendisplay>
- **Example Code:** <https://support.newhavendisplay.com/hc/en-us/categories/4409527834135-Example-Code/>
- **Knowledge Center:** https://www.newhavendisplay.com/knowledge_center.html
- **Quality Center:** 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
-	03/20/2024	Initial Release	KL
1	05/06/2024	Updated Pinout to Support 4-wire SPI Part Revision Upgraded to Rev2B	KL
2	05/23/2024	Mechanical Drawing Updated	KL
3	06/27/2024	Contrast Ratio Updated	KL
4	07/22/2024	Updated Wiring Diagrams	KL
5	03/11/2025	Mechanical Drawing Updated	KL

Mechanical Drawing



1	GND	21	DB7
2	YD (NC)	22	DB8
3	XL (NC)	23	DB9
4	YU (NC)	24	DB10
5	XR (NC)	25	DB11
6	SD0	26	DB12
7	VDD	27	DB13
8	VDDI	28	DB14
9	SDA	29	DB15
10	CSX	30	RESX
11	DCX	31	IM0
12	WRX	32	IM1
13	RDX	33	IM2
14	DB0	34	LEDK1
15	DB1	35	LEDK2
16	DB2	36	LEDK3
17	DB3	37	LEDK4
18	DB4	38	LEDA
19	DB5	39	GND
20	DB6	40	TE

Product Description: 2.4" 240x320 IPS TFT

1. Driver IC: ST7789VI

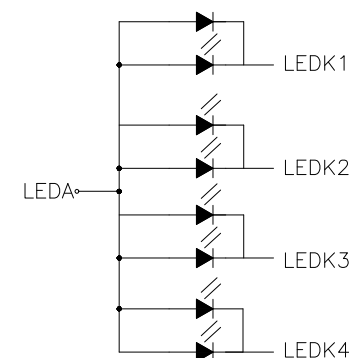
2. Interface: 8/16-bit 8080 Parallel, 3/4-wire SPI

3. Power Requirement: 3.3V TFT, 3.0V/160mA Backlight

4. Optical Features: Normally Black, Transmissive, Anti-Glare, 1200cd/m²

5. Recommended FFC Connector: 40pin 0.5mm pitch; Ex. Molex 54132-4062

6. Built-in EMI Shielding



LED CIRCUIT

Standard Tolerance:
(Unless otherwise specified)

Linear: $\pm 0.3 \text{ mm}$

Unless otherwise specified:
• Dimensions are in Millimeters
• Third Angle Projection

NEWHAVEN DISPLAY
INTERNATIONAL

Drawing/Part Number: NHD-2.4-240320AF-CSXP
Revision: 2B

Drawn By: K. Lewis
Approved By: K. Lewis
Drawn Date: 03/11/2025
Approved Date: 03/11/2025

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Pin Description

Pin No.	Symbol	External Connection	Function Description
1	GND	Power Supply	Ground
2	NC	-	No Connect
3	NC	-	No Connect
4	NC	-	No Connect
5	NC	-	No Connect
6	SDO	MPU	Serial Data Out
7	VDD	Power Supply	Supply Voltage for LCD (3.3V)
8	VDDI	Power Supply	Supply Voltage for Logic
9	SDA	MPU	Serial Data In
10	CSX	MPU	Active LOW Chip Select signal
11	DCX	MPU	Data / Command selection: '1' = Data; '0' = Command
12	WRX	MPU	Active LOW Write signal
13	RDX	MPU	Active LOW Read signal
14	DB0	MPU	Bi-directional data bus 8-bit: use DB8-DB15 16-bit: use DB0-DB15
15	DB1	MPU	
16	DB2	MPU	
17	DB3	MPU	
18	DB4	MPU	
19	DB5	MPU	
20	DB6	MPU	
21	DB7	MPU	
22	DB8	MPU	
23	DB9	MPU	
24	DB10	MPU	
25	DB11	MPU	
26	DB12	MPU	
27	DB13	MPU	
28	DB14	MPU	
29	DB15	MPU	
30	RESX	MPU	Active LOW Reset signal
31	IM0	MPU	Interface Mode Select
32	IM1	MPU	Interface Mode Select
33	IM2	MPU	Interface Mode Select
34	LED-K1	Power Supply	Backlight Cathode (Ground)
35	LED-K2	Power Supply	
36	LED-K3	Power Supply	
37	LED-K4	Power Supply	
38	LED-A	Power Supply	Backlight Anode (3.0V/160mA)
39	GND	Power Supply	Ground
40	TE	MPU	Tearing Effect Output

Recommended LCD connector: 40-pin, 0.5mm pitch FFC connector

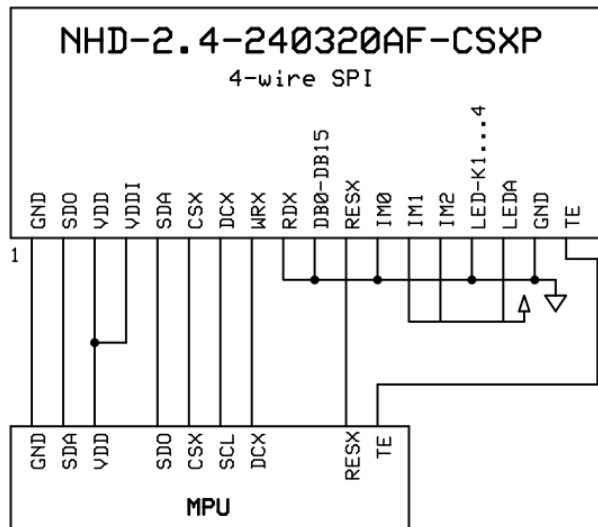
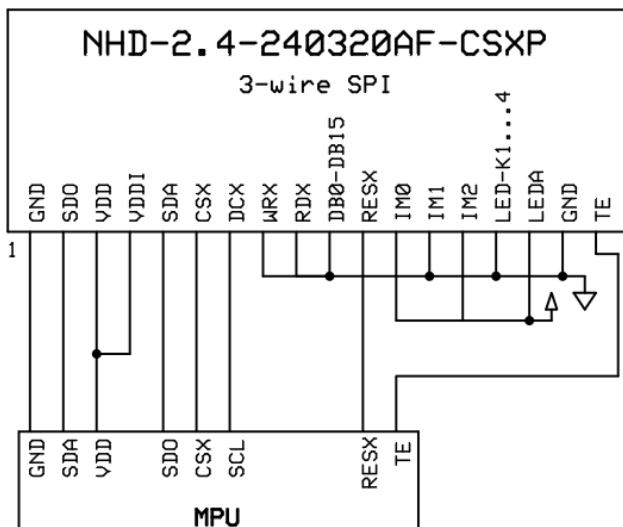
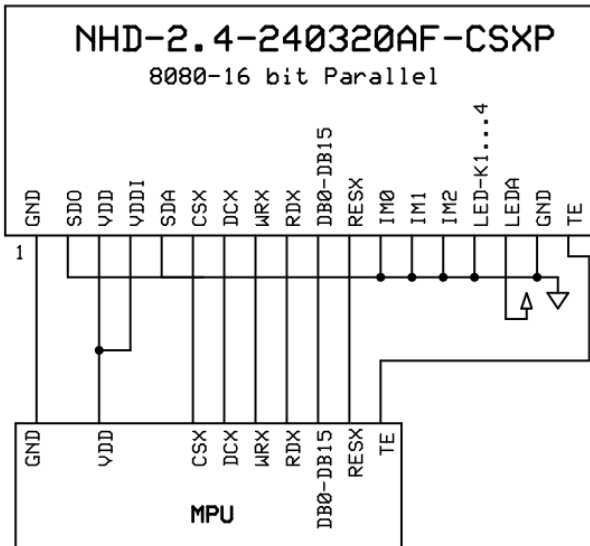
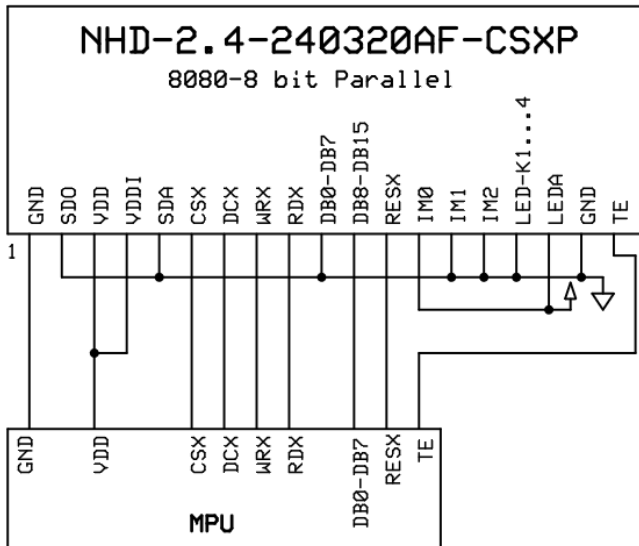
Molex P/N: 54132-4062 or similar

Interface Selection

Pin Name	8-bit 8080-II Parallel	16-bit 8080-II Parallel	3-wire SPI	4-wire SPI
IM0	1	0	1	0
IM1	0	0	0	1
IM2	0	0	1	1



Wiring Diagram



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 for LCD	V _{DD}	-	2.4	3.3	3.6	V
Supply Voltage for Logic	V _{DDI}	-	1.65	1.8	3.6	V
Supply Current	I _{DD}	V _{DD} = 3.3V	5	10	15	mA
"H" Level input	V _{IH}	-	0.7 * V _{DDI}	-	V _{DDI}	V
"L" Level input	V _{IL}	-	GND	-	0.3 * V _{DDI}	V
"H" Level output	V _{OH}	-	0.8 * V _{DDI}	-	V _{DDI}	V
"L" Level output	V _{OL}	-	GND	-	0.2 * V _{DDI}	V
Backlight Supply Current	I _{LED}	-	80	160	200	mA
Backlight Supply Voltage	V _{LED}	I _{LED} = 160mA	2.7	3.0	3.4	V
Backlight Lifetime*	-	I _{LED} = 160mA T _{OP} = 25°C	30,000	50,000	-	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

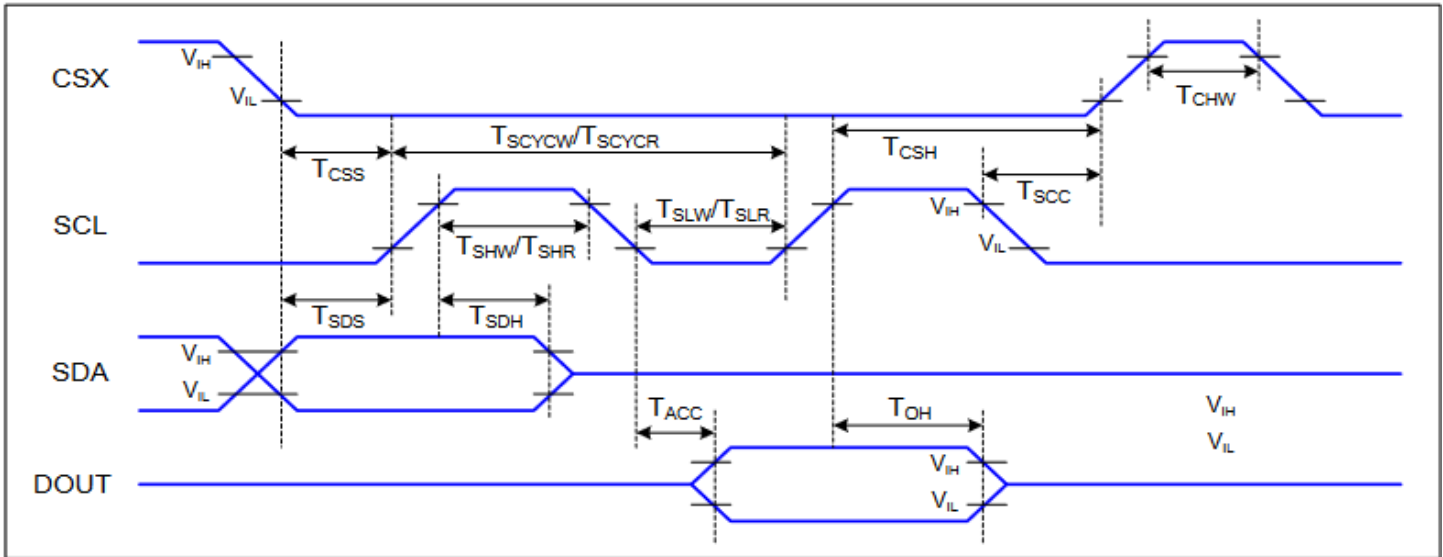
Item		Symbol	Condition	Min.	Typ.	Max.	Unit
Optimal Viewing Angles	Top	φY+	CR ≥ 10	-	80	-	°
	Bottom	φY-		-	80	-	°
	Left	θX-		-	80	-	°
	Right	θX+		-	80	-	°
Contrast Ratio		CR	-	800	1500	-	-
Luminance		L _V	I _{LED} = 160mA	1000	1200	-	cd/m ²
Response Time		T _R + T _F	T _{OP} = 25°C	-	35	45	ms
Chromaticity	Red	X _R	-	0.585	0.635	0.685	-
		Y _R	-	0.291	0.341	0.391	-
	Green	X _G	-	0.276	0.326	0.376	-
		Y _G	-	0.569	0.619	0.669	-
	Blue	X _B	-	0.105	0.155	0.205	-
		Y _B	-	0.026	0.076	0.126	-
	White	X _W	-	0.283	0.313	0.343	-
		Y _W	-	0.299	0.329	0.359	-

Controller Information

Built-in ST7789VI Controller: <https://support.newhavendisplay.com/hc/en-us/articles/10814990300823-ST7789VI>

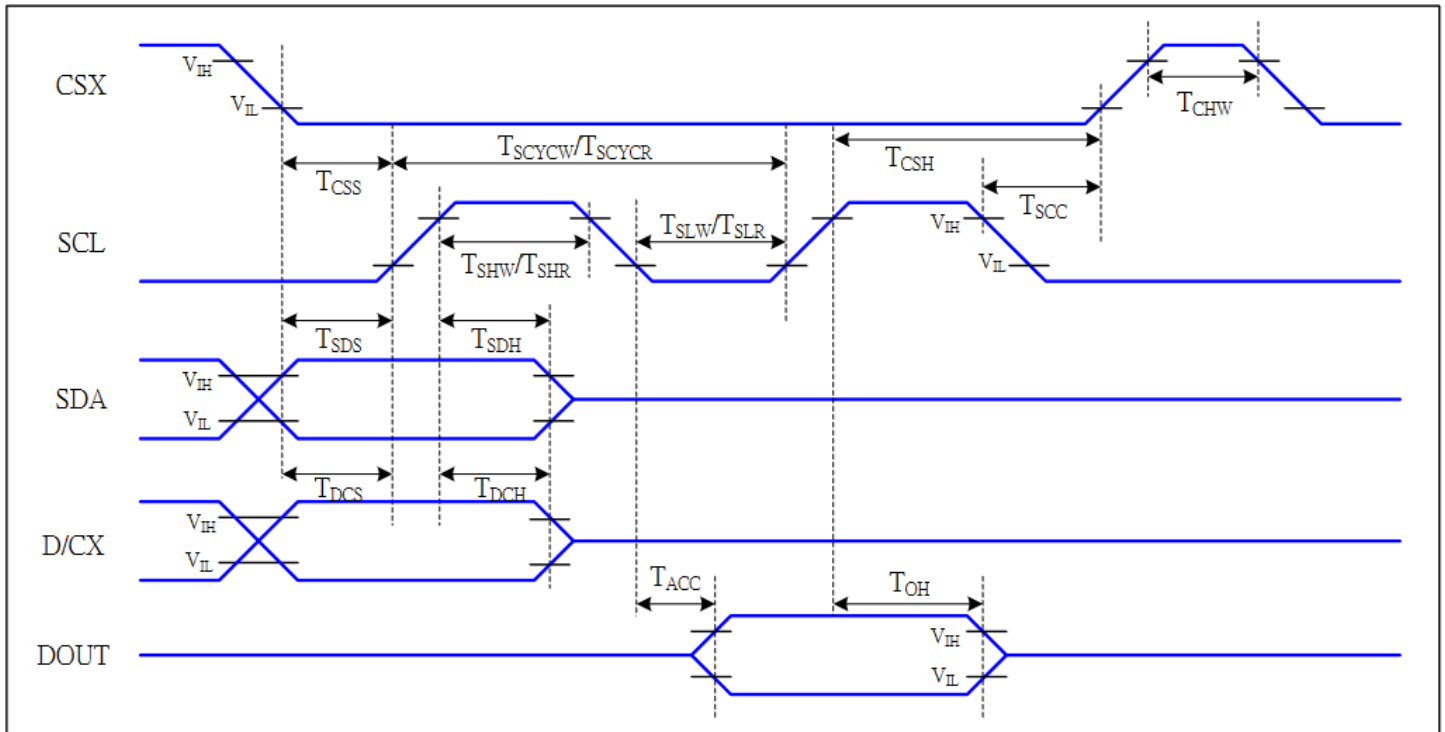


3-wire Serial interface Timing Characteristics



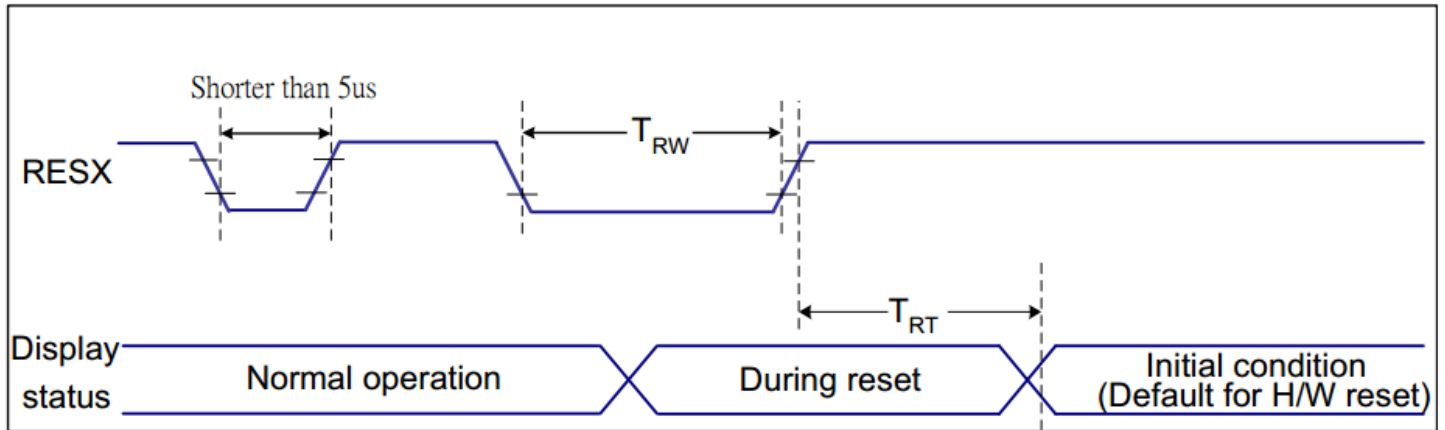
Signal	Symbol	Parameter	Min	Max	Unit	Description
CSX	T_{CSS}	Chip select setup time (write)	15		ns	
	T_{CSH}	Chip select hold time (write)	15		ns	
	T_{CSS}	Chip select setup time (read)	60		ns	
	T_{SCC}	Chip select hold time (read)	65		ns	
	T_{CHW}	Chip select "H" pulse width	40		ns	
SCL	T_{SCYCW}	Serial clock cycle (Write)	16		ns	
	T_{SHW}	SCL "H" pulse width (Write)	7		ns	
	T_{SLW}	SCL "L" pulse width (Write)	7		ns	
	T_{SCYCR}	Serial clock cycle (Read)	150		ns	
	T_{SHR}	SCL "H" pulse width (Read)	60		ns	
	T_{SLR}	SCL "L" pulse width (Read)	60		ns	
SDA (DIN)	T_{SDS}	Data setup time	7		ns	
	T_{SDH}	Data hold time	7		ns	
DOUT	T_{ACC}	Access time	10	50	ns	For maximum CL=30pF
	T_{OH}	Output disable time	15	50	ns	For minimum CL=8pF

4-wire Serial interface Timing Characteristics



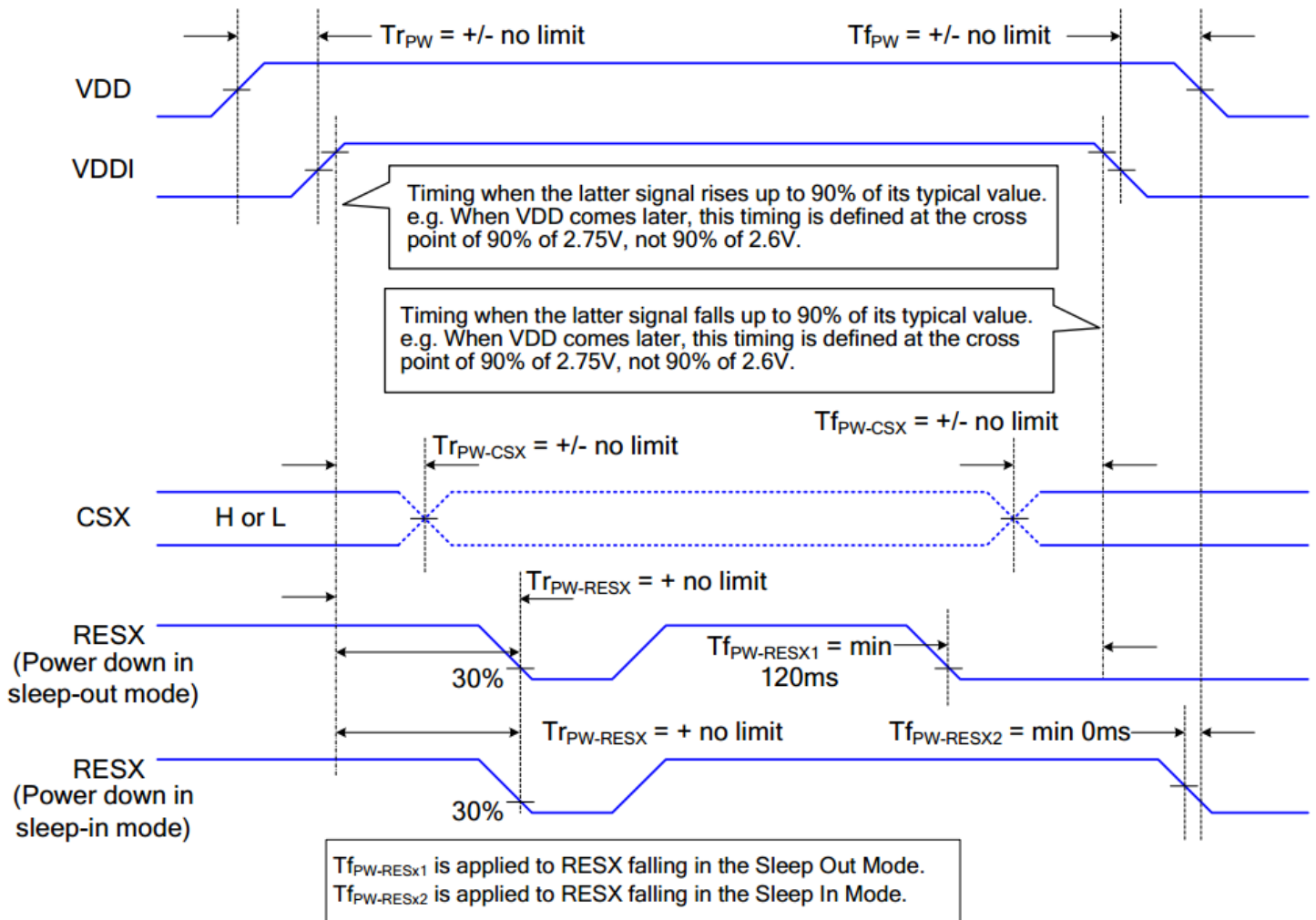
Signal	Symbol	Parameter	MIN	MAX	Unit	Description
CSX	T _{CSS}	Chip select setup time (write)	15		ns	
	T _{CSH}	Chip select hold time (write)	15		ns	
	T _{CSS}	Chip select setup time (read)	60		ns	
	T _{SCC}	Chip select hold time (read)	65		ns	
	T _{CHW}	Chip select "H" pulse width	40		ns	
SCL	T _{SCYCW}	Serial clock cycle (Write)	16		ns	-write command & data ram
	T _{SHW}	SCL "H" pulse width (Write)	7		ns	
	T _{SLW}	SCL "L" pulse width (Write)	7		ns	
	T _{SCYCR}	Serial clock cycle (Read)	150		ns	-read command & data ram
	T _{SHR}	SCL "H" pulse width (Read)	60		ns	
	T _{SLR}	SCL "L" pulse width (Read)	60		ns	
D/CX	T _{DCS}	D/CX setup time	10		ns	
	T _{DCH}	D/CX hold time	10		ns	
SDA (DIN)	T _{SDS}	Data setup time	7		ns	
	T _{SDH}	Data hold time	7		ns	
DOUT	T _{ACC}	Access time	10	50	ns	For maximum CL=30pF
	T _{OH}	Output disable time	15	50	ns	For minimum CL=8pF

Reset Timing



Related Pins	Symbol	Parameter	MIN	MAX	Unit
RESX	TRW	Reset pulse duration	10	-	us
	TRT	Reset cancel	-	5 (Note 1, 5)	ms
				120 (Note 1, 6, 7)	ms

Power ON/OFF Sequence



Example Initialization Code

```

/*****/
void Command_out(unsigned char c) //Function used for sending commands to TFT
{
    PORTA &= ~(1 << PORTA3); // Set DCX pin to LOW
    PORTL=c; // Assigning the Command Byte 'c' to PortL
    PORTA &= ~(1 << PORTA7); // Set WRX pin to LOW
    PORTA |= (1 << PORTA7); // Set WRX pin to HIGH
}

/*****/
void data_out(unsigned char d) //Function used for sending data to TFT
{
    PORTA |= (1 << PORTA3); // Set DCX pin to HIGH
    PORTL=d; // Assigning the Data Byte 'd' to PortL
    PORTA &= ~(1 << PORTA7); // Set WRX pin to LOW
    PORTA |= (1 << PORTA7); // Set WRX pin to HIGH
}

/*****/
void TFT_init(){

    digitalWrite(RESEX, LOW);
    delay(250);
    digitalWrite(RESEX, HIGH);
    delay(250);

    Command_out(0x28); //display off
    Command_out(0x11); //exit SLEEP mode
    delay(100);

    Command_out(0x36); //MADCTL: memory data access control
    data_out(0x88);

    Command_out(0x3A); //COLMOD: Interface Pixel format *** 65K-colors in 16bit/pixel (5-
6-5) format when using 16-bit interface to allow 1-byte per pixel
    data_out(0x55);

    Command_out(0xB2); //PORCTRK: Porch setting
    data_out(0x0C);
    data_out(0x0C);
    data_out(0x00);
    data_out(0x33);
    data_out(0x33);

    Command_out(0xB7); //GCTRL: Gate Control
    data_out(0x35);

    Command_out(0xBB); //VCOMS: VCOM setting
    data_out(0x2B);

    Command_out(0xC0); //LCMCTRL: LCM Control
    data_out(0x2C);

    Command_out(0xC2); //VDVVRHEN: VDV and VRH Command Enable
    data_out(0x01);
    data_out(0xFF);
  
```

```

Command_out(0xC3); //VRHS: VRH Set
data_out(0x11);

Command_out(0xC4); //VDVS: VDV Set
data_out(0x20);

Command_out(0xC6); //FRCTRL2: Frame Rate control in normal mode
data_out(0x0F);

Command_out(0xD0); //PWCTRL1: Power Control 1
data_out(0xA4);
data_out(0xA1);

Command_out(0xE0); //PVGAMCTRL: Positive Voltage Gamma control
data_out(0xD0);
data_out(0x00);
data_out(0x05);
data_out(0x0E);
data_out(0x15);
data_out(0x0D);
data_out(0x37);
data_out(0x43);
data_out(0x47);
data_out(0x09);
data_out(0x15);
data_out(0x12);
data_out(0x16);
data_out(0x19);

Command_out(0xE1); //NVGAMCTRL: Negative Voltage Gamma control
data_out(0xD0);
data_out(0x00);
data_out(0x05);
data_out(0x0D);
data_out(0x0C);
data_out(0x06);
data_out(0x2D);
data_out(0x44);
data_out(0x40);
data_out(0x0E);
data_out(0x1C);
data_out(0x18);
data_out(0x16);
data_out(0x19);

Command_out(0x2A); //X address set
data_out(0x00);
data_out(0x00);
data_out(0x00);
data_out(0xEF);

Command_out(0x2B); //Y address set
data_out(0x00);
data_out(0x00);
data_out(0x01);
data_out(0x3F);
delay(10);
Command_out(0x21); //Color inversion for IPS
Command_out(0x29); //display ON
delay(10);
}

```

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.	+60°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.	-30°C 30min -> 25°C 3min -> 80°C 30min = 1 cycle. For 100 cycles	
Vibration test	Endurance test applying vibration to simulate transportation and use.	10Hz-55Hz (1 min.), 1.5mm amplitude. 30 min. exposure for each directions X,Y,Z	3
Static electricity test	Endurance test applying electric static discharge.	Air charge: ±8kV 10 Times Contact charge: ±4kV 10 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.