4DLCD-144-128-128-SQ-NT-NM-300-S

- 1.44" TFT-LCD
- Colour active matrix TFT-LCD module

Datasheet

www.4dlcd.com

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Revision History

REVISION	DATE	COMMENT	REMARKS
1.0	04/03/2018	Initial Draft	Initial Draft Version

Table of Contents

1. General Specification

4DLCD-144-128-128-SQ-NT-NM-300-S is a colour active matrix LCD module incorporating amorphous silicon TFT (Thin Film Transistor). It is composed of a colour TFT-LCD panel, driver IC, FPC and a back light unit. The module display area contains 128 x 128 pixels. This product accords with RoHS environmental criterion.

ITEM		CONTENTS	UNIT
LCD Type		TFT / Transmissive / Normally white	
Size		1.44	Inch
Viewing Direction		6:00 (without image inversion)	O'Clock
Gray Scale Inversion Direction		12:00	O'Clock
LCD (W × H)		30 x 33.03	mm^2
Active Area (W × H)		25.5 × 26.5	mm^2
Dot Pitch (W × H)		0.1992 × 0.207	mm^2
Number of Dots (Pixels)		128RGB) × 128	
Driver IC		ST7735S	
Backlight Type		2 LEDs	
Surface Luminance	4DLCD-144-128-128-SQ-NT-NM-300-S	300 (typical)	cd/m^2
Interface Type		SPI	
Color Depth		262K	
Pixel Arrangement		RGB Vertical Stripe	
Surface Treatment		AG	
Input Voltage		2.8 (typical)	V
With/Without TP		4DLCD-144-128-128-SQ-NT-NM-300-S	
Weight	-	-	g

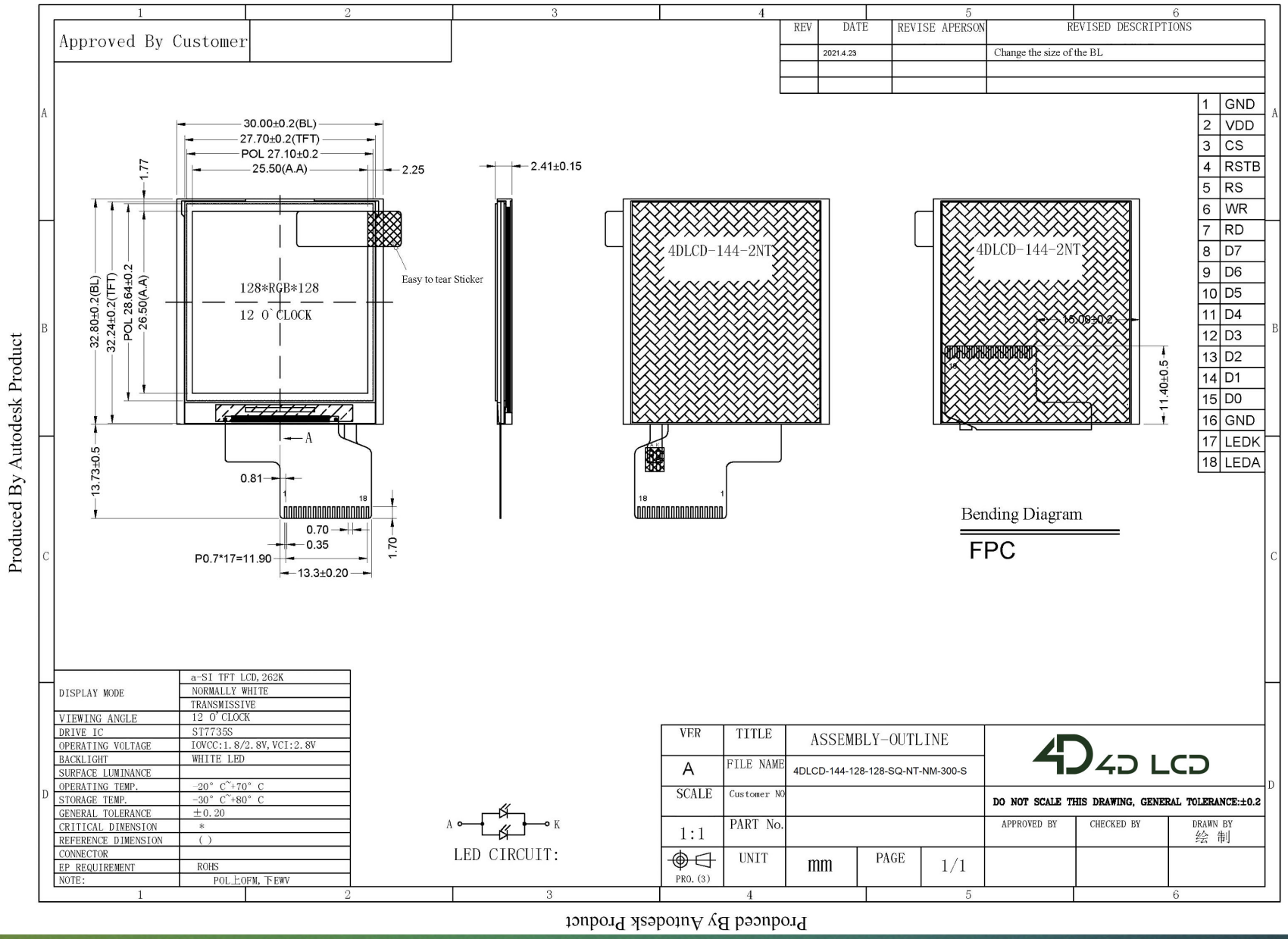
Note 1: RoHS compliant
Note 2: LCD weight tolerance: ± 5%.

Part Number Details:
NT - Non Touch
RP - Resistive Touch
CP - Capacitive Touch
EAR - Metal or Plastic EARs
CLB - Glass Cover Lenz Bezel
NM - No Mounting
L - LVDS
D - MIPI/DSI
R - RGB
S - SPI
M8 - MCU 8bit
M16 - MCU 16bit

2. TFT LCD Display Drawing (Non Touch Version)

4DLCD-144-128-128-SQ-NT-NM-300-S

Produced By Autodesk Product



3. Absolute Maximum Ratings

PARAMETER	SYMBOL	MIN	MAX	UNIT
Supply Voltage for LCD Logic	VDD/VCC	-0.3	4.6	V
Supply Voltage for TP Logic	VDD/VCC-VSS	-	-	V
Input Voltage for Logic	VIN	VSS-0.5	VDD	V
LED forward voltage (each LED)	IF	-	25	mA
Operating Temperature	T_{OP}	-20	70	°C
Storage Temperature	T_{ST}	-30	80	°C
Humidity	RH	-	90% (Max 60°C	RH

4. Electrical Characteristics

PARAMETER	SYMBOL	MIN	TYP	MAX	UNIT
Power Voltage	VDD/DCC	2.6	2.8	3.3	V
Input Current	IVDD	-	-	-	mA
Input Voltage 'H' Level	V_{IH}	0.7 VDD	-	VDD	V
Input Voltage 'L' Level	V_{IL}	0	-	0.3 VDD	V

5. Electro-Optical Characteristics

ITEM		SYM	CONDITION	MIN	TYP	MAX	UNIT	REMARK
Response Time		Tr+Tf	θ=0	-	-	32	ms	Figure 1 (4)
Contrast Ratio		Cr	°	400	600	-	-	Figure 2 (1)
Luminance Uniformity		δ WHITE	ø=0	-	50	-	%	Figure 2 (3)
Surface Luminance		Lv	NMLCD-14412812	150			cd/m_2	Figure 2 (2)
Viewing Angle Range		θ	ø = 90°	-	60	-	deg	Figure 3 (6)
			ø = 270°	-	60	-	deg	
			ø = 0°	-	60	-	deg	
			ø = 180°	-	60	-	deg	
CIE (x,y) Cromaci	Red	x	θ=0° ø=0° Ta=25	-0.02	0.626	+0.02		Figure 2 (5)
		y		-0.02	0.310	+0.02		
	Green	x		-0.02	0.296	+0.02		
		y		-0.02	0.518	+0.02		
	Blue	x		-0.02	0.142	+0.02		
		y		-0.02	0.141	+0.02		
	White	x		-0.02	0.295	+0.02		
		y		-0.02	0.327	+0.02		

6. Backlight Characteristics

PARAMETER	SYMBOL	MIN	TYP	MAX	UNIT
Voltage for LED backlight	V_l	-	3.2	3.4	V
Current for LED backlight	I_l	-	40	50	mA
LED Life Time	-	30000	-	-	Hrs

Note: The LED life time is defined as the module brightness decrease to 50% original brightness

at Ta=25°C. **Note 1**: Contrast Ratio(CR) is defined mathematically as below, for more information

see Figure 1.

$$\text{Contrast Ratio} = \frac{\text{Average Surface Luminance with all black pixels (P1, P2, P3, P4, P5)}}{\text{Average Surface Luminance with all white pixels (P1, P2, P3, P4, P5)}}$$

Note 2: Surface luminance is the LCD surface from the surface with all pixels displaying white.
For more information, see Figure 2.

Lv = Average Surface Luminance with all white pixels (P1, P2, P3, P4, P5)

Note 3: The uniformity in surface luminance δ WHITE is determined by measuring luminance at each test position 1 through 5, and then dividing the maximum luminance of 5 points luminance by minimum luminance of 5 points luminance. For more information, see Figure 2.

$$\delta \text{ WHITE} = \frac{\text{Minimum Surface Luminance with all white pixels (P1, P2, P3, P4, P5)}}{\text{Maximum Surface Luminance with all white pixels (P1, P2, P3, P4, P5)}}$$

Note 4: Response time is the time required for the display to transition from white to black (Rise Time, Tr) and from black to white (Decay Time, Tf). For additional information see FIG 1. The test equipment is Autronic-Melchers ConoScope series.

Note 5: CIE (x, y) chromaticity, the x, y value is determined by measuring luminance at each test position 1 through 5, and then make average value.

Note 6: Viewing angle is the angle at which the contrast ratio is greater than 2. For TFT module the contrast ratio is greater than 10. The angles are determined for the horizontal or x axis and the vertical or y axis with respect to the z axis which is normal to the LCD surface. For more information, see Figure3.

Note 7: For viewing angle and response time testing, the testing data is based on Autronic-Melchers ConoScope series. Instruments for Contrast Ratio, Surface Luminance, Luminance Uniformity, CIE the test data is based on TOPCONs BM-5 photo detector.

Figure 1. The definition of response time

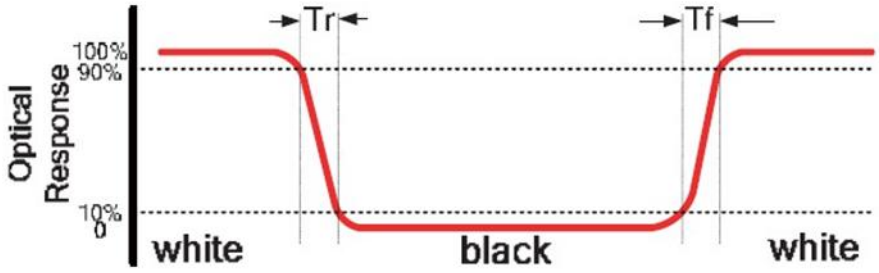


Figure 2. Measuring method for Contrast ratio, surface luminance, Luminance uniformity, CIE (x, y) chromaticity

A : 5 mm
B : 5 mm
H, V : Active Area
Light spot size ∅=5mm, 500mm distance from the LCD surface to detector lens
measurement instrument is TOPCON's luminance meter BM-5

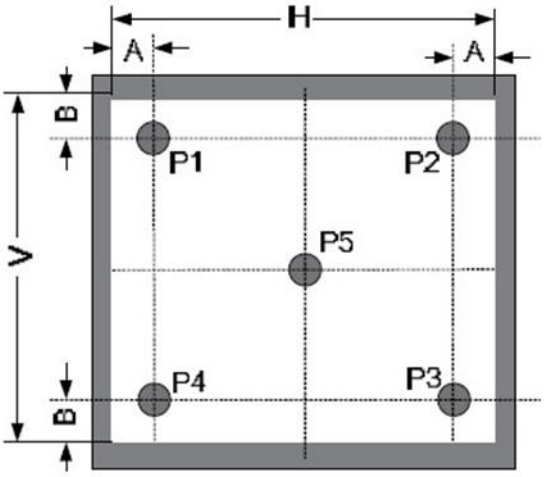
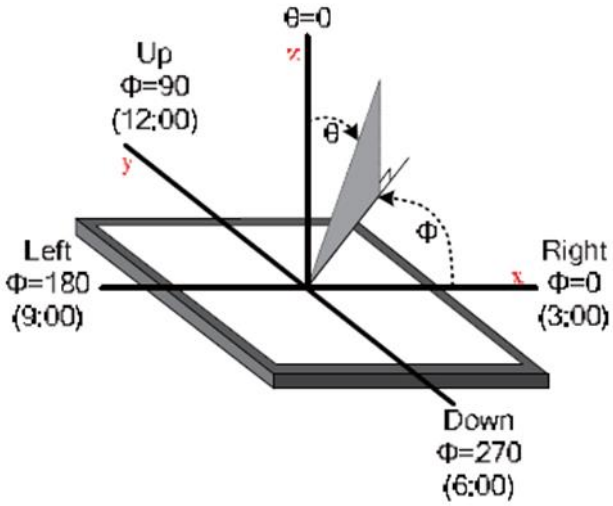


Figure 3. The definition of viewing angle



7. Interface Descriptions

7.1. LCD Interface

PIN NO.	SYMBOL	DESCRIPTION	REMARK
1	LEDA	Anode of LED Backlight	
2	LEDK	Cathode1 of LED Backlight	
3	RESET	Reset input signal	
4	DC	Serves as command or parameter select	
5	SDA	serial input/output signal in serial interface	
6	NC	No Connect	
7	SCL	Serial interface clock	
8	CS	Chip select input pin	
9	VCC	Power supply	
10	GND	Ground	
11	NC	No Connect	
12	NC	No Connect	
13	NC	No Connect	
14	NC	No Connect	

8. Initialisation Code

```
LCD_RESET=1;
Delayms (1);                    //Delay 1ms
LCD_RESET=0;
Delayms (1);                    //Delay 1ms
LCD_RESET=1;
Delayms (120);                    //Delay 120ms
//---------------------------------End ST7735S Reset Sequence ---------------------------------------//

WriteComm(0x11); //Sleep out
Delayms (120);       //Delay 120ms

//---------------------------------ST7735S Frame rate----------------------------------------//
WriteComm(0xB1); //Frame rate 80Hz
WriteData(0x02);
WriteData(0x35);
WriteData(0x36);

WriteComm(0xB2); //Frame rate 80Hz
WriteData(0x02);
WriteData(0x35);
WriteData(0x36);

WriteComm(0xB3); //Frame rate 80Hz
WriteData(0x02);
WriteData(0x35);
WriteData(0x36);
WriteData(0x02);
WriteData(0x35);
WriteData(0x36);
//---------------------------------End ST7735S Frame rate----------------------------------------//

WriteComm(0xB4); //Dot inversion
WriteData(0x03);
//---------------------------------ST7735S Power Sequence----------------------------------------//

WriteComm(0xC0);
WriteData(0xA2);
WriteData(0x02);
WriteData(0x84);
WriteComm(0xC1);
WriteData(0xC5);
WriteComm(0xC2);
WriteData(0x0D);
WriteData(0x00);
WriteComm(0xC3);
WriteData(0x8D);
WriteData(0x2A);
WriteComm(0xC4);
WriteData(0x8D);
WriteData(0xEE);
//---------------------------------End ST7735S Power Sequence---------------------------------------//

WriteComm(0xC5); //VCOM
WriteData(0x03);

WriteComm(0x36); //MX, MY, RGB mode
WriteData(0xC8);
```

```
//-------------------------------------ST7735S Gamma Sequence-------------------------------------//
WriteComm(0XE0);
WriteData(0x12);
WriteData(0x1C);
WriteData(0x10);
WriteData(0x18);
WriteData(0x33);
WriteData(0x2C);
WriteData(0x25);
WriteData(0x28);
WriteData(0x28);
WriteData(0x27);
WriteData(0x2F);
WriteData(0x3C);
WriteData(0x00);
WriteData(0x03);
WriteData(0x03);
WriteData(0x10);
WriteComm(0XE1);
WriteData(0x12);
WriteData(0x1C);
WriteData(0x10);
WriteData(0x18);
WriteData(0x2D);
WriteData(0x28);
WriteData(0x23);
WriteData(0x28);
WriteData(0x28);
WriteData(0x26);
WriteData(0x2F);
WriteData(0x3B);
WriteData(0x00);
WriteData(0x03);
WriteData(0x03);
WriteData(0x10);
//-------------------------------------End ST7735S Gamma Sequence-------------------------------------//

WriteComm(0x3A); //65k mode
WriteData(0x05);

WriteComm(0x29); //Display on
WriteComm(0x2C);

}
```

8.1. Timing Chart

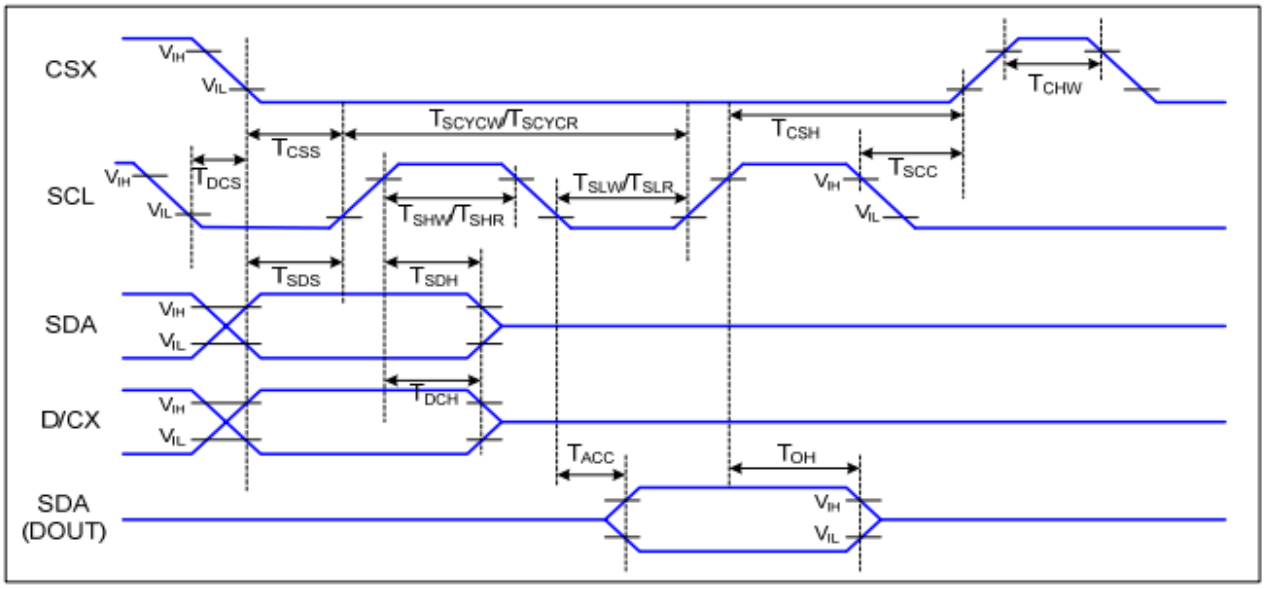
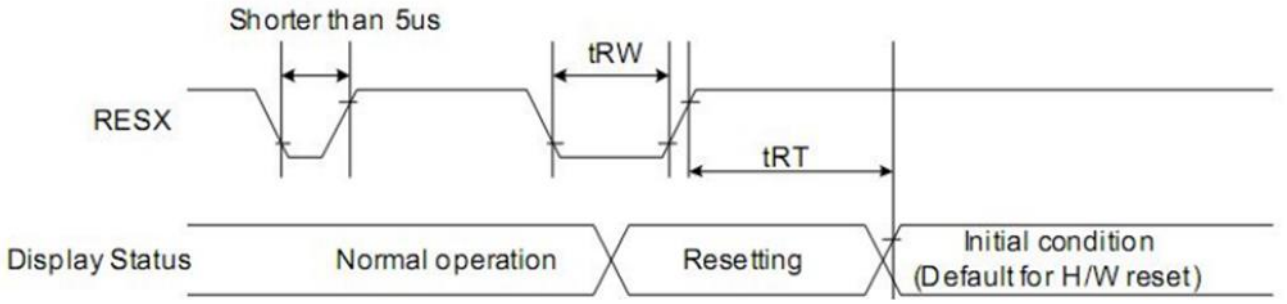


Figure 7 4-line Serial Interface Timing

Ta=25 ℃, VDDI=1.65~3.7V, VDD=2.5~4.8V

Signal	Symbol	Parameter	MIN	MAX	Unit	Description
CSX	TCSS	Chip Select Setup Time (Write)	45		ns	
	TCSH	Chip Select Hold Time (Write)	45		ns	
	TCSS	Chip Select Setup Time (Read)	60		ns	
	TSCC	Chip Select Hold Time (Read)	65		ns	
	TCHW	Chip Select “H” Pulse Width	40		ns	
SCL	TSCYCW	Serial Clock Cycle (Write)	66		ns	-Write Command & Data Ram
	TSHW	SCL “H” Pulse Width (Write)	15		ns	
	TSLW	SCL “L” Pulse Width (Write)	15		ns	
	TSCYCR	Serial Clock Cycle (Read)	150		ns	-Read Command & Data Ram
	TSHR	SCL “H” Pulse Width (Read)	60		ns	
	TSLR	SCL “L” Pulse Width (Read)	60		ns	
D/CX	TDCS	D/CX Setup Time	10		ns	
	TDCH	D/CX Hold Time	10		ns	
SDA (DIN) (DOUT)	TSDS	Data Setup Time	10		ns	For Maximum CL=30pF For Minimum CL=8pF
	TSDH	Data Hold Time	10		ns	
	TACC	Access Time	10	50	ns	
	TOH	Output Disable Time	15	50	ns	

8.2. Reset Timing

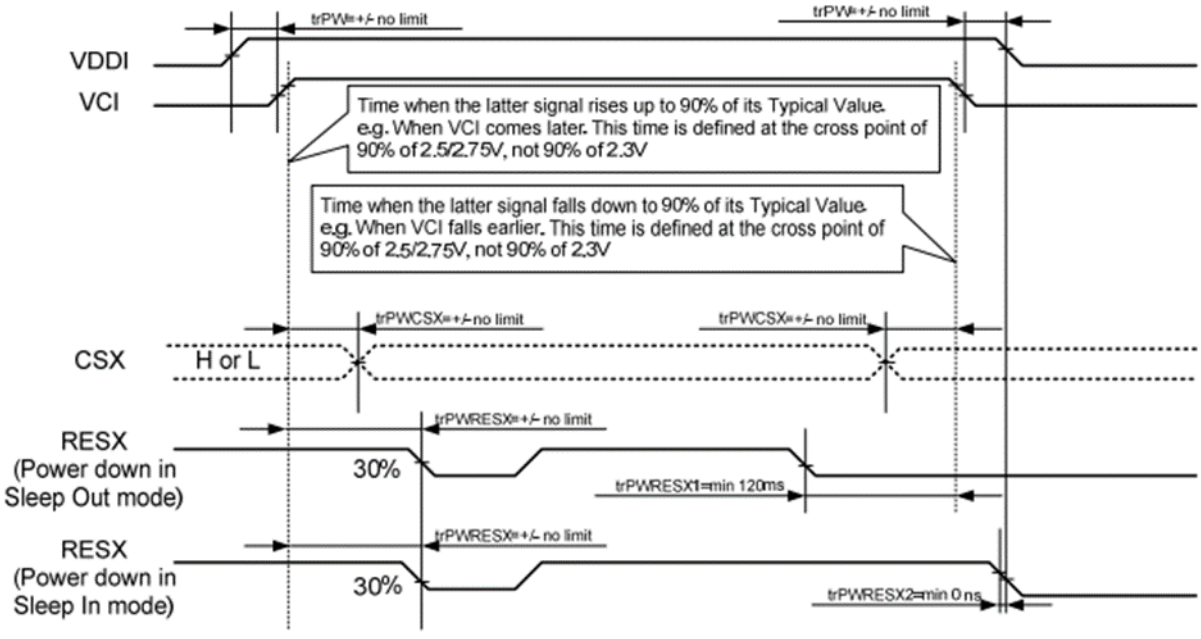


SIGNAL	SYMBOL	PARAMETER	MIN	MAX	UNIT
RESET	tRW	Reset low pulse width	10	-	us
	tRT	Reset complete time	-	5 (note1)	ms
			-	120 (note2)	ms

Note 1: When reset applied during SLPIN mode
Note 2: When reset applied during SLPOUT mode.

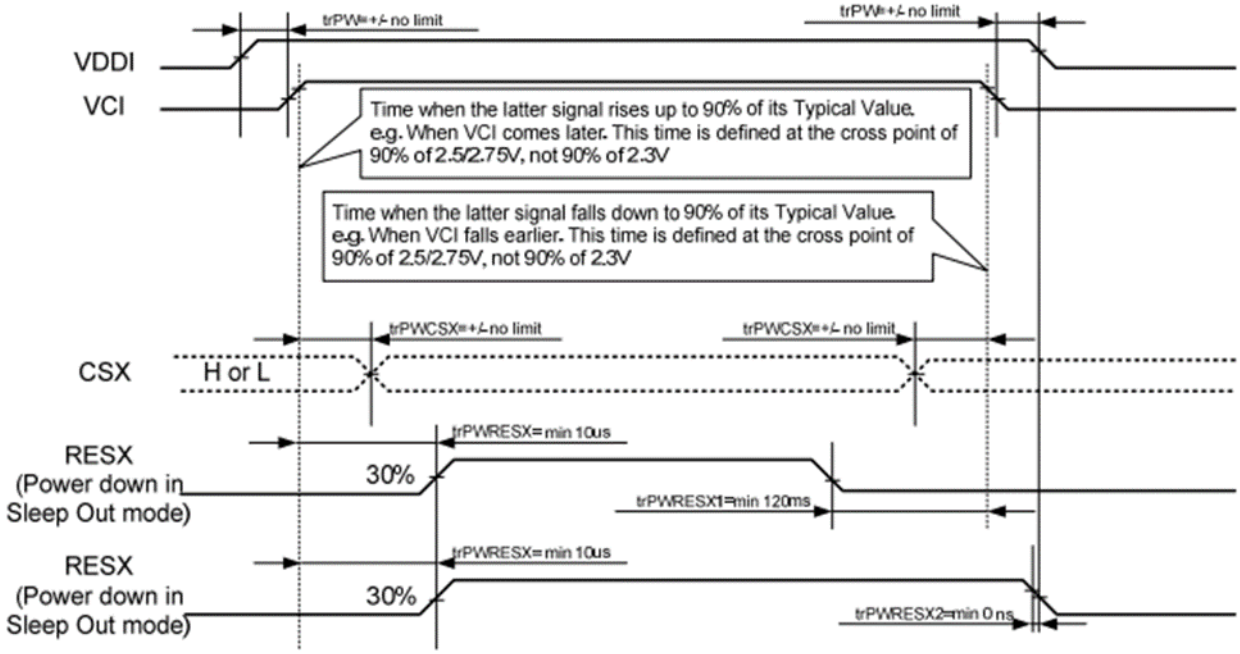
8.3. Power On Sequence

8.3.1. Case 1 - RES line is held High or Unstable by Host at Power ON



trPWRESX1 is applied to RESX falling in the Sleep Out Mode
trPWRESX2 is applied to RESX falling in the Sleep In Mode

8.3.2. Case 2 - RES line is held Low by Host at Power ON



trPWRESX1 is applied to RESX falling in the Sleep Out Mode
trPWRESX2 is applied to RESX falling in the Sleep In Mode

8.4. Power-off Sequence - Uncontrolled Power Off

Uncontrolled power off is a situation where power is removed unexpectedly, e.g. a battery powering a device is disconnected without using the controlled power off sequence. There will not be any damage to the display module, nor will the display module cause any damage to the host. During an uncontrolled power off event, ILI9341V will force the display to blank its content and there will not be any further abnormal visible effects on the display after 1 second of the power being removed. The display will remain blank until the Power On Sequence occurs.

9. Reliability Test

No.	SYMBOL	TEST CONDITION	REMARK
1	High Temperature Storage	80℃±2℃ 96H Restore 2H at 25℃ Power off	After test cosmetic and electrical defects should not happen.
2	Low Temperature Storage	-30℃±2℃ 96H Restore 2H at 25℃ Power off	
3	High Temperature Operation	70℃±2℃ 96H Power on	
4	Low Temperature Operation	-20℃±2℃ 96H Power	
5	High Temperature & Humidity Operation	60℃±2℃ 90%RH 96H Power on	
6	Temperature Cycle	-20℃←→25℃←→70℃ 30min 5min 30min After 10 cycles, restore 2H at 25℃ Power off	
7	Vibration Test	10Hz~150Hz, 100m/s^2, 120min	
8	Shock Test	Half-sinewave, 300m/s^2, 11ms	

10. Precautions for Using LCD Module

10.1. Handing Precautions

(1) The display panel is made of glass. Do not subject it to a mechanical shock or impact by dropping it.

(2) If the display panel is damaged and the liquid crystal substance leaks out, be sure not to get any in your mouth. If the substance contacts your skin or clothes, wash it off using soap and water.

(3) Do not apply excessive force to the display surface or the adjoining areas since this may cause the color tone to vary.

4) The polarizer covering the display surface of the LCD module is soft and easily scratched. Handle this polarizer carefully.

(5) If the display surface becomes contaminated, breathe on the surface and gently wipe it with a soft dry cloth. If it is heavily contaminated, moisten a cloth with one of the following solvents:

- Isopropyl alcohol

(6) Ethyl alcohol

(6) Solvents other than those above mentioned may damage the polarizer.

Especially, do not use the following:

- Water
- Ketone
- Aromatic solvents

(7) Extra care to minimize corrosion of the electrode. Water droplets, moisture condensation or a current flow in a high-humidity environment accelerates corrosion of the electrode.

(8) Install the LCD Module by using the mounting holes. When mounting the LCD Module, make sure it is free of twisting, warping and distortion. In particular, do not forcibly pull or bend the I/O cable or the backlight cable.

(9) Do not attempt to disassemble or process the LCD Module.

(10) NC terminal should be open. Do not connect anything.

(11) If the logic circuit power is off, do not apply the input signals.

(12) To prevent destruction of the elements by static electricity, be careful to maintain an optimum work environment.

- Be sure to ground the body when handling he LCD Module.
- Tools required for assembling, such as soldering irons, must be properly grounded.
- To reduce the amount of static electricity generated, do not conduct assembling and other work under dry conditions.

-The LCD Module is coated with a film to protect the display surface. Exercise care when peeling off this protective film since static electricity may be generated.

10.2. Storage Precautions

When storing The LCD Module, avoid exposure to direct sunlight of fluorescent lamps. Keep the modules in bags (avoid high temperature/ high humidity and low temperatures below 0ć). Whenever possible, the LCD Module should be stored in the same conditions in which they were shipped from our company.

10.3. Others

Liquid crystals solidify under low temperature (below the storage temperature range) leading to defective orientation or the generation of air bubbles (black or white). Air bubbles may also be generated if the module is subject to a low

temperature.

If the LCD Module have been operating for a long time showing the same display patterns the display

patterns may

remain on the screen as ghost images and a slight contrast irregularity may also appear. A normal operating status

can be recovered by suspending use for some time. It should be noted that this phenomenon does not adversely affect

performance reliability.

To minimize the performance degradation of the LCD Module resulting from destruction caused by static electricity etc. exercise care to avoid holding the following sections when handling the modules.

- Exposed area of the printed circuit board.
- Terminal electrode sections.

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