

MODEL NO : LCDT28961801-SPIMODEL VERSION: 01SPEC VERSION : 2.9ISSUED DATE: 2015-12-08

- ☐ Preliminary Specification
☒ Final Product Specification

Customer : _____

App oved by	Notes

LCD Confirmed :

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This technical specification is subjected to change without notice

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[illegible]

1 General Specifications

Feature		Spec
Display Spec.	Size	2.4"
	Resolution	240(RGB)x320
	Technology Type	a-si TFT
	Pixel Configuration	RGB Vertical Stripe
	Pixel pitch(mm)	0.153 x 0.153
	Display Mode	CT,NW
	Surface Treatment	Clear Type
	Viewing Direction	12 o'clock
	Gray Scale Inversion Direction	6 o'clock
Mechanical Characteristics	LCM (W x H x D) (mm)	50 x 69.72
	Active Area(mm)	43.2 x 57.60
	With /Without TSP	With RTP
	Matching Connection Type	18pin-0.8mm
	LED Numbers	4
	Weight (g)	12
Electrical Characteristics	Interface	SPI 4 WIRE
	Color Depth	262K
	Driver IC	st7789v2

Note 1: Viewing direction for best image quality is different from TFT definition. There is a 180 degree shift.

Note 2: Requirements on Environmental Protection: Q/S0002

Note 3: LCM weight tolerance: $\pm 5\%$

2 Input/Output Terminals

Matched connector: 18pin-0.8mm

PIN No.	Symbol	Description
1	GND	Ground (接地脚)
2	RESET	LCM Reset pin Signal is active low. (屏复位脚, 低电平复位)
3	SCL	This pin is used serial interface clock in 4-wire 8-bit serial data interface. (4线串口的时钟信号) If not used, this pin should be connected to IOVCC or GND. (不用时接IOVCC或者接地)
4	D/C	- 4-line system (D/CX): Serves as command or parameter select. Fix to IOVCC level when not in use. (4线串口的寄存器/数据选择, 不用时接 IOVCC)
5	CS	Chip select pin ("Low" enable) (屏驱动芯片片选脚, 低电平有效)
6	SDA	Serial input signal. The data is applied on the rising edge of the SCL signal. If not used, fix this pin at IOVCC or GND (串口数据输入信号, 不用时接 IOVCC 或者接地)
7	SDO	Serial output signal. The data is outputted on the falling edge of the SCL signal. If not used, open this pin (串口数据输出信号, 不用时悬空)
8	GND	Ground (接地脚)
9	VCC	Power supply for LCM (2.8V-3.3V) (屏供电脚)
10	LEDA	Anode of Backlight (3.0V-3.4V Typical:3.2V) (背光正极供电脚, 电压范围:3.0-3.4V, 典型值:3.2V)
11	LEDK1	Cathode of Backlight (背光负极供电脚)
12	LEDK2	Cathode of Backlight (背光负极供电脚)
13	LEDK3	Cathode of Backlight (背光负极供电脚)
14	LEDK4	Cathode of Backlight (背光负极供电脚)
15	XL	Touch panel control pin (触摸屏控制脚)
16	YU	Touch panel control pin (触摸屏控制脚)
17	XR	Touch panel control pin (触摸屏控制脚)
18	YD	Touch panel control pin (触摸屏控制脚)

Note1,, Please add the FPC connector type and matched one if necessary .

3 Absolute Maximum Ratings

GND=0V

Item	Symbol	MIN	MAX	Unit	Remark
Power Voltage	VCC	-0.3	4.6	V	Note1
Input voltage	V _{IN}	-0.3	4.6	V	
Operating Temperature	Top	-20	70	°C	
Storage Temperature	Tst	-30	80	°C	
Relative Humidity Note2	RH	--	--95	%	Ta --40°C
		--	--85	%	40°C<Ta --50°C
		--	--55	%	50°C<Ta --60°C
		--	--36	%	60°C<Ta --70°C
		--	--24	%	70°C<Ta --80°C
Absolute Humidity	AH	--	--70	g/m ³	Ta>70°C

Table 3 Absolute Maximum Ratings

Note1: Input voltage include R0~R5, G0~G5, B0~B5, Dotclk, Hsync, Vsync, Enable, R/L, U/D.

Note2: Ta means the ambient temperature.

It is necessary to limit the relative humidity to the specified temperature range.

Condensation on the module is not allowed.

4 Electrical Characteristics

4.1 LCD Module

GND=0V, Ta=25?

Item		Symbol	MIN	TYP	MAX	Unit	Remark
Logic Supply Voltage		IOVCC	2.5	2.8	3.3+/-10%	V	
Analog Supply Voltage		VCC	2.5	2.8	3.3+/-10%	V	
Input Signal Voltage	High Level	VIH	0.7 IOVCC	-	IOVCC	V	
	Low Level	VIL	-	-	0.3 IOVCC	V	
Output Signal Voltage	High Level	VOH	0.8 IOVCC	-	-	V	
	Low Level	VOL	-	-	0.2 IOVCC	V	
(Panel+LSI) Power Consumption		Black Mode	-	30	36	mW	
		Sleeping Mode	-	0.047	0.057	mW	

Table 4.1 LCD module electrical characteristics

4.2 Backlight Unit

Ta=25?

Item	Symbol	MIN	TYP	MAX	Unit	Remark
Forward Current	I _F	-	15	-	mA	One LED
Forward Voltage	V _F	(2.9)	3.2	(3.4)	V	One LED
Backlight Power Consumption	W _{BL}	-	192	-	mW	4 LEDs
Lifetime	T	-	20000	-	Hr	One LED

Table 4.2.1 backlight unit electrical characteristics

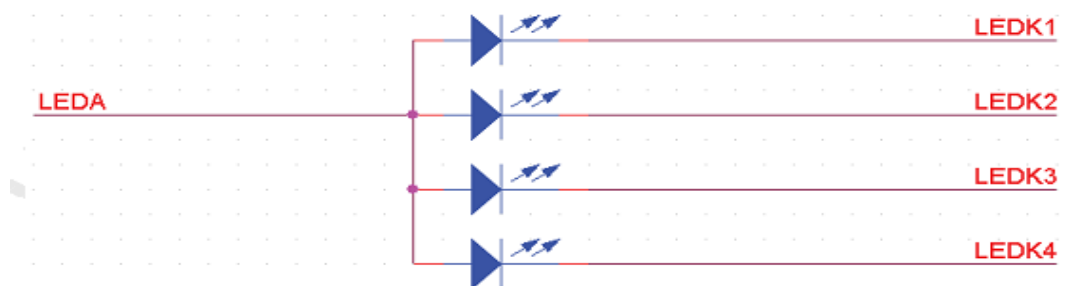
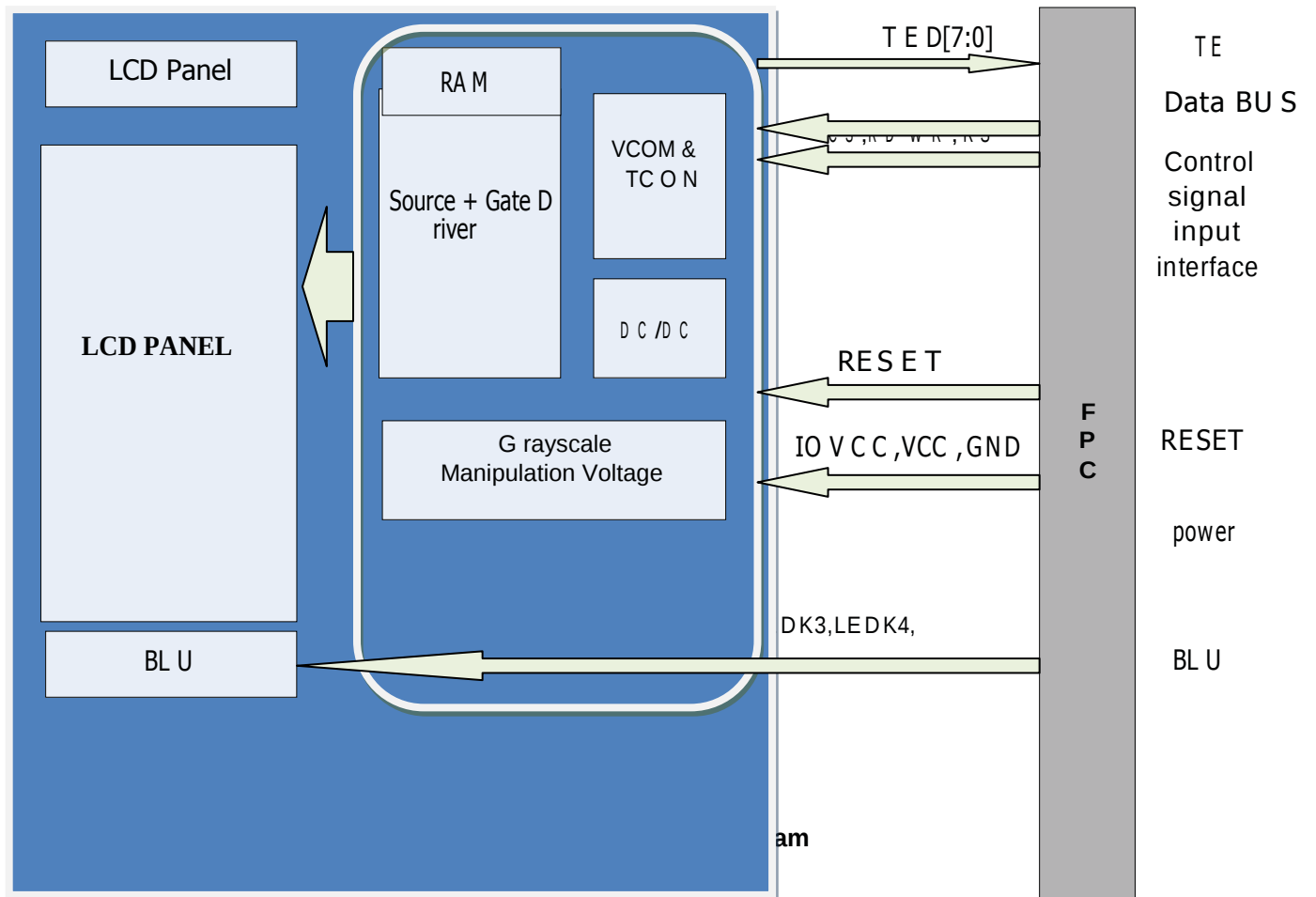
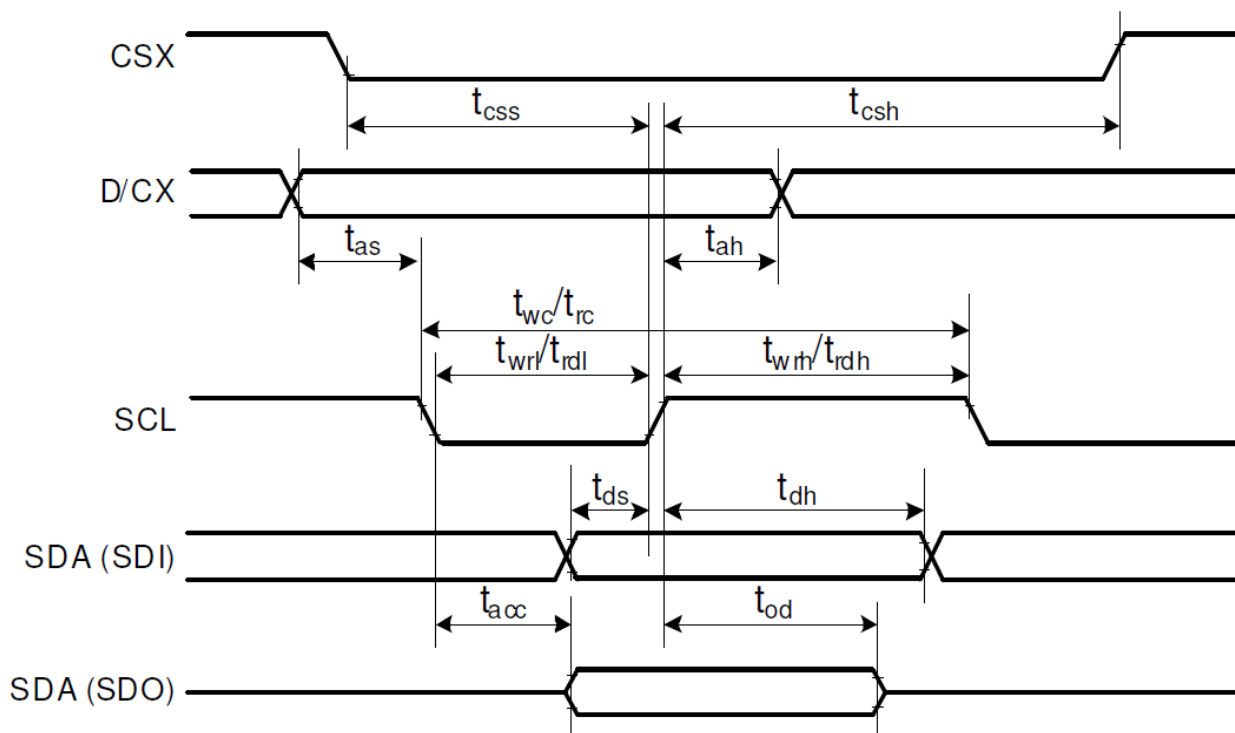


Figure 4.2.1 LED backlight circuit

4.3 Block Diagram



5 Timing Chart



Signal	Symbol	Parameter	min	max	Unit	Description
CSX	t_{css}	Chip select time (Write)	40	-	ns	
	t_{csh}	Chip select hold time (Read)	40	-	ns	
SCL	t_{wc}	Serial clock cycle (Write)	100	-	ns	
	t_{wrh}	SCL "H" pulse width (Write)	40	-	ns	
	t_{wr}	SCL "L" pulse width (Write)	40	-	ns	
	t_{rc}	Serial clock cycle (Read)	150	-	ns	
	t_{rdh}	SCL "H" pulse width (Read)	60	-	ns	
	t_{rdl}	SCL "L" pulse width (Read)	60	-	ns	
D/CX	t_{as}	D/CX setup time	10	-		
	t_{ah}	D/CX hold time (Write / Read)	10	-		
SDA / SDI (Input)	t_{ds}	Data setup time (Write)	30	-	ns	
	t_{dh}	Data hold time (Write)	30	-	ns	
SDA / SDO (Output)	t_{acc}	Access time (Read)	10	-	ns	For maximum $C_L=30pF$
	t_{od}	Output disable time (Read)	10	50	ns	For minimum $C_L=8pF$

Note: $T_a = -30$ to $70\text{ }^{\circ}\text{C}$, $V_{DDI}=1.65\text{V}$ to 3.3V , $V_{CI}=2.5\text{V}$ to 3.3V , $V_{SS}=0\text{V}$

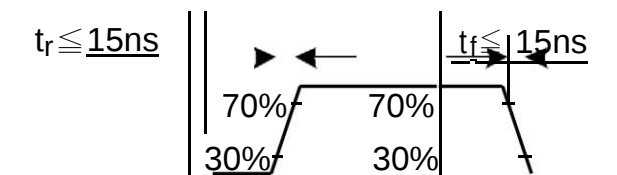


Table 5.1 timing parameter

5.2. Register write / read timing

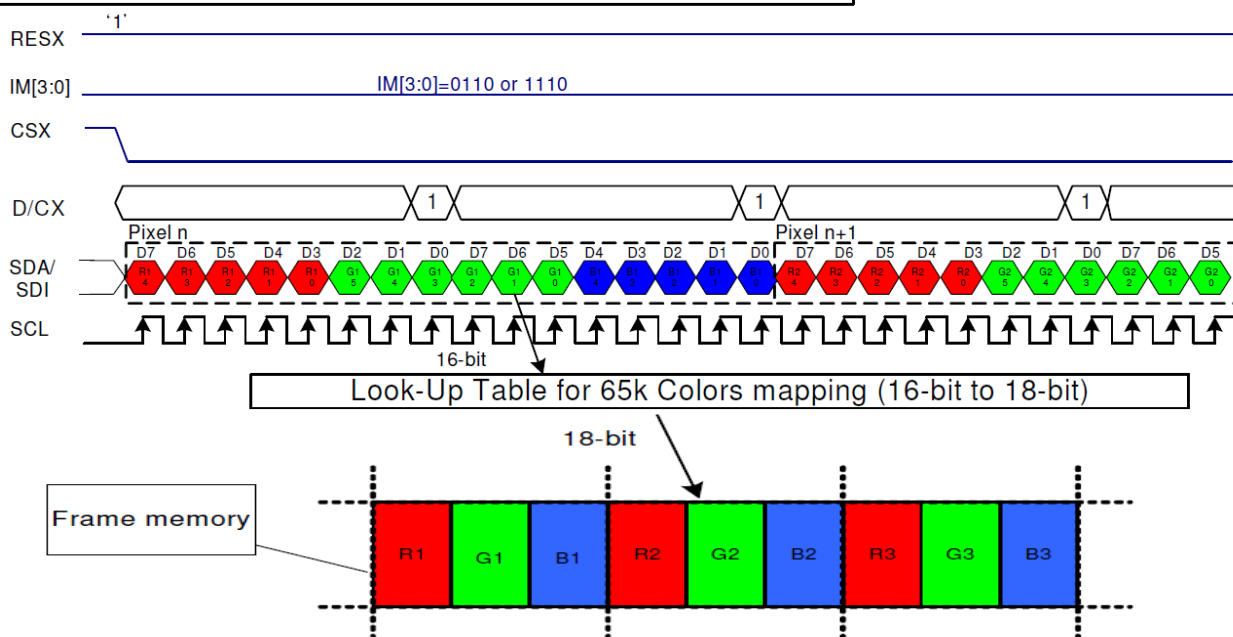
a. Write to register

In 4-line serial interface, different display data format is available for two color depths supported by the LCM listed below.

-65k colors, RGB 5, 6, 5 -bits input.

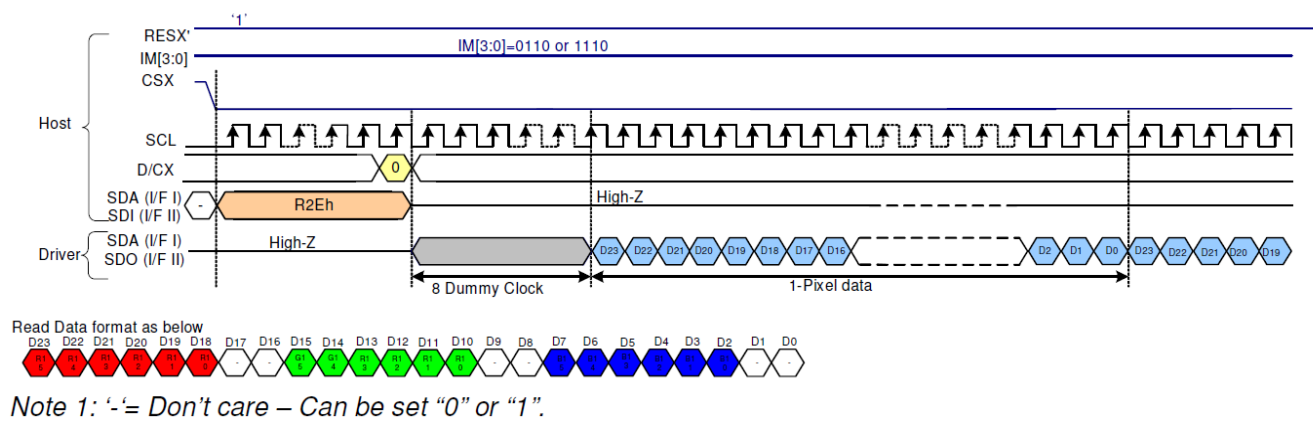
-262k colors, RGB 6, 6, 6 -bits input.

16 bit/pixel color order (R:5-bit, G:6-bit, B:5-bit), 65,536 colors



b. Read from register

Read data through 4-line SPI mode



CS timings

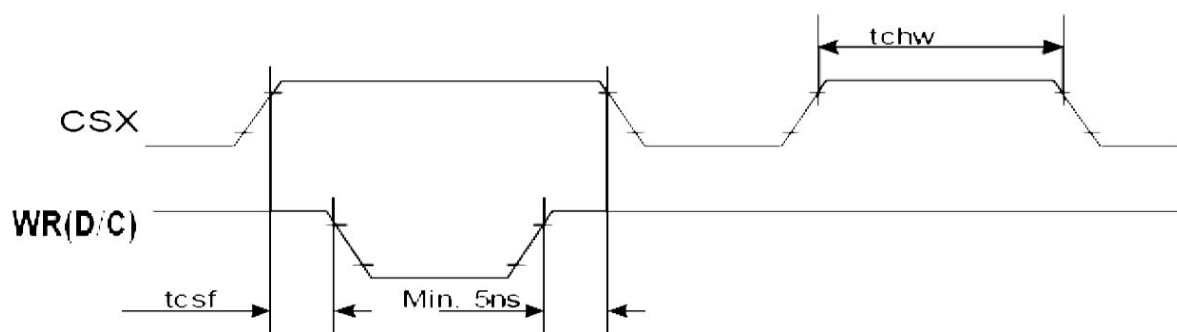


Figure 5.2.3 Chip selection timing

Write to read or read to write timings

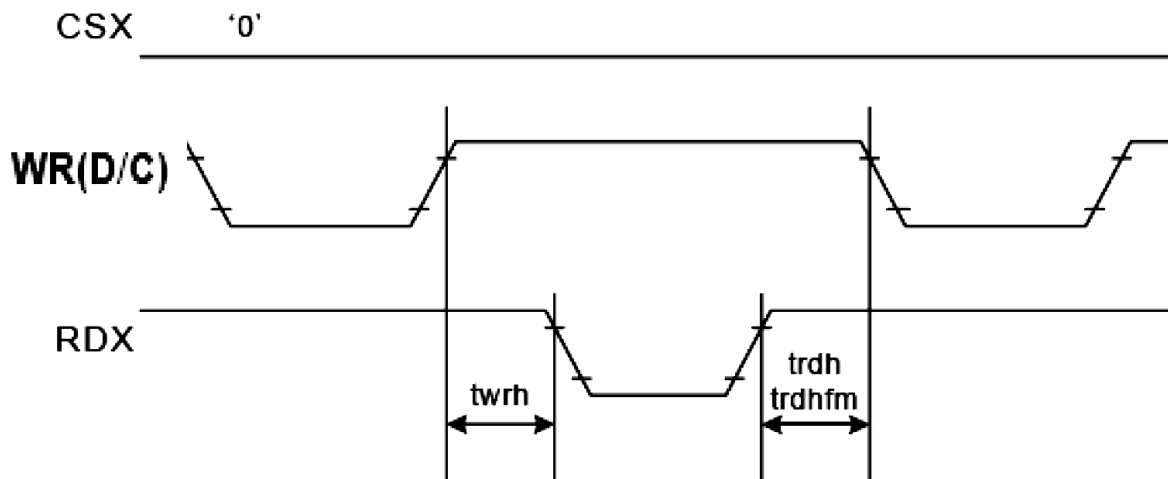
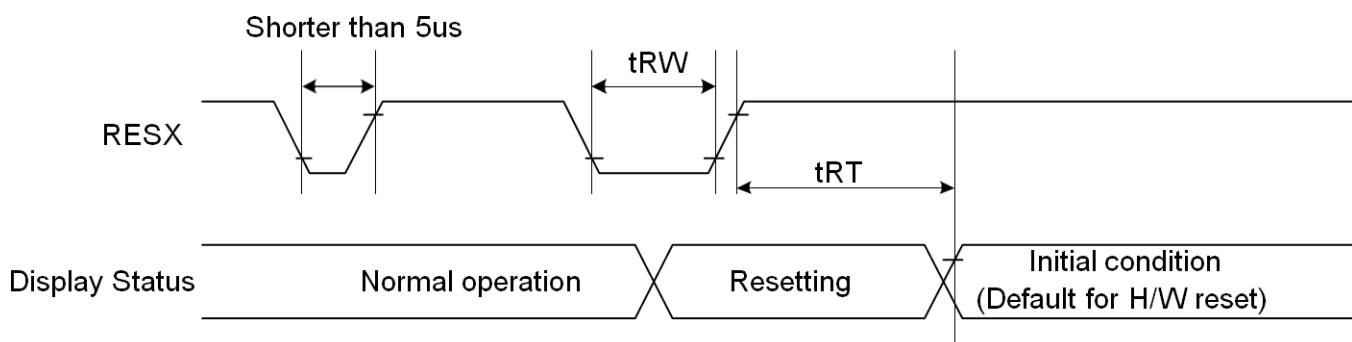


Figure 5.2.4 Write-to-read and read-to-write timing

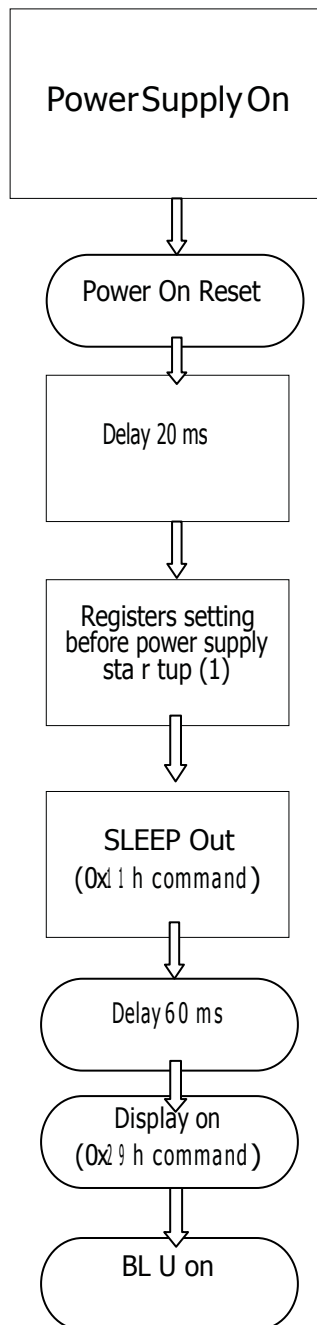
5. 3 Reset Timing Characteristics



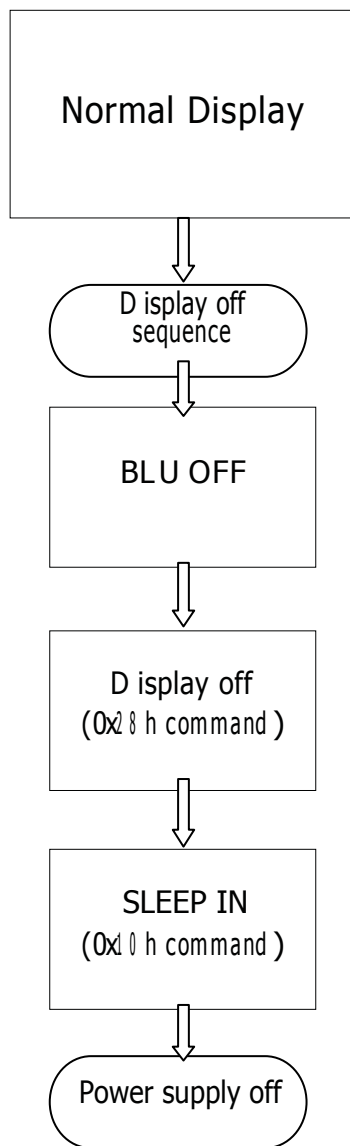
Signal	Symbol	Parameter	Min	Max	Unit
RESX	tRW	Reset pulse duration	10		uS
	tRT	Reset cancel		5 (note 1,5)	mS
				120 (note 1,6,7)	mS

Figure 5.3 RESET Timing

5.4 Power on Sequence



5.5 Power off Sequence



6.Optical Characteristics

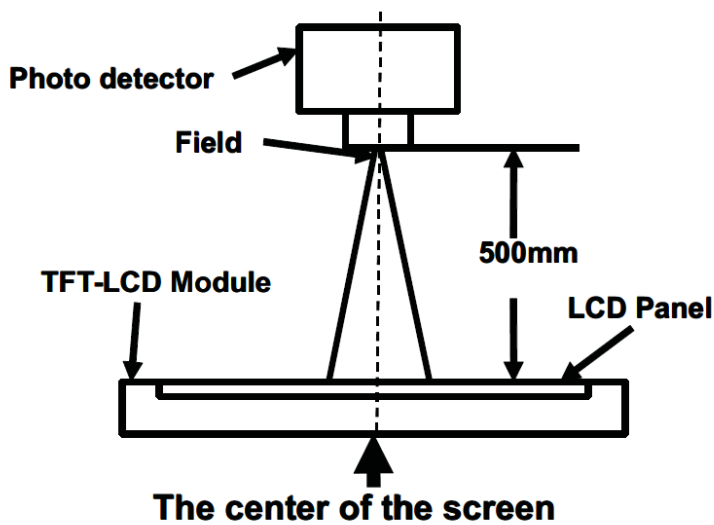
Item		Symbol	Condition	Min	Typ	Max	Unit	Remark
View Angles		0T	CRŠ10	60	70	60	Degree	Note2,3
		0B		50	60	50		
		0L		60	70	60		
		0R		60	70	60		
Contrast Ratio		CR	0=0°	400	500	400		Note 3
Response Time		T _{ON}	25 °C		20	30	ms	Note 4
		T _{OFF}						
Chromaticity	White	x	Backlight is on	0.236	0.286	0.336		Note 1,5
		y		0.261	0.311	0.361		
	Red	x		0.530	0.580	0.630		Note 1,5
		y		0.270	0.320	0.370		
	Green	x		0.288	0.338	0.388		Note 1,5
		y		0.531	0.581	0.631		
	Blue	x		0.101	0.151	0.201		Note 1,5
		y		0.048	0.098	0.148		
Uniformity		U		-	80%		%	Note 6
NTSC				-	50%		%	Note 5
Luminance		L		180	200		cd/m²	Note 7

Test Conditions:

1. I_F= 60mA, and the ambient temperature is 25℃.
2. The test systems refer to Note 1 and Note 2.

Note 1: Definition of optical measurement system.

The optical characteristics should be measured in dark room. After 5 Minutes operation, the optical properties are measured at the center point of the LCD screen. All input terminals LCD panel must be ground when measuring the center area of the panel.



Item	Photo detector	Field
Contrast Ratio	SR-3A	1°
Luminance		
Chromaticity		
Lum Uniformity		
Response Time	BM-7A	2°

Note 2: Definition of viewing angle range and measurement system.

viewing angle is measured at the center point of the LCD by CONOSCOPE(ergo-80).

Note 3: Definition of contrast ratio

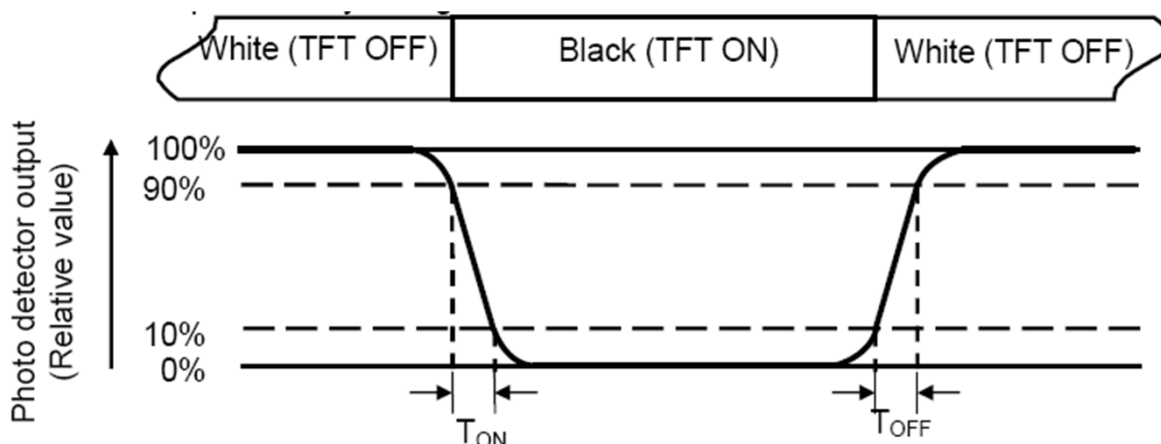
“White state “: The state is that the LCD should drive by V_{white} .

“Black state”: The state is that the LCD should drive by V_{black} .

V_{white}: To be determined V_{black}: To be determined.

Note 4: Definition of Response time

The response time is defined as the LCD optical switching time interval between “White” state and “Black” state. Rise time (T_{ON}) is the time between photo detector output intensity changed from 90% to 10%. And fall time (T_{OFF}) is the time between photo detector output intensity changed from 10% to 90%.



Note 5: Definition of color chromaticity (CIE1931)

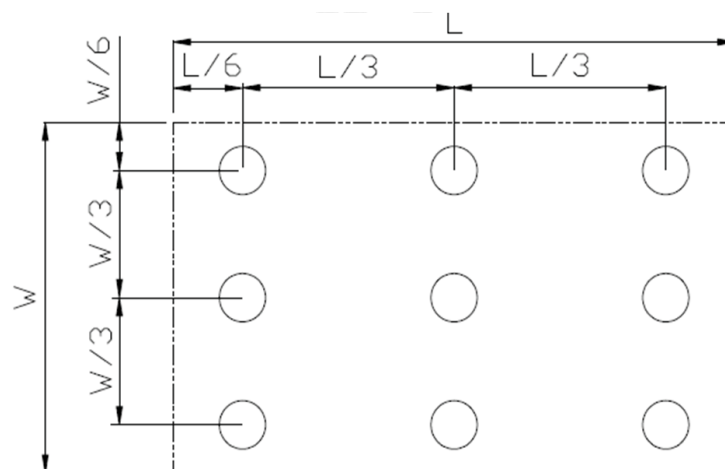
Color coordinates measured at center point of LCD.

Note 6: Definition of Luminance Uniformity

Active area is divided into 9 measuring areas (Refer Fig. 2). Every measuring point is placed at the center of each measuring area.

$$\text{Luminance Uniformity (U)} = L_{\min} / L_{\max}$$

L-----Active area length W----- Active area width



L_{max}: The measured Maximum luminance of all measurement position.

L_{min}: The measured Minimum luminance of all measurement position.

Note 7: Definition of Luminance:

Measure the luminance of white state at center point.

9 Precautions for Use of LCD Modules

8.1 Handling Precautions

8.1.1 The display panel is made of glass. Do not subject it to a mechanical shock by dropping it from a high place, etc.

8.1.2 If the display panel is damaged and the liquid crystal substance inside it leaks out, be sure not to get any in your mouth, if the substance comes into contact with your skin or clothes, promptly wash it off using soap and water.

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

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

8.1.5 If the display surface is contaminated, breathe on the surface and gently wipe it with a soft dry cloth. If still not completely clear, moisten cloth with one of the following solvents:

- Isopropyl alcohol
- Ethyl alcohol

Solvents other than those mentioned above may damage the polarizer. Especially, do not use the following:

- Water
- Ketone
- Aromatic solvents

8.1.6 Do not attempt to disassemble the LCD Module.

8.1.7 If the logic circuit power is off, do not apply the input signals.

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

8.1.8.1 Be sure to ground the body when handling the LCD Modules.

8.1.8.2 Tools required for assembly, such as soldering irons, must be properly ground.

8.1.8.3 To reduce the amount of static electricity generated, do not conduct assembly and other work under dry conditions.

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

8.2 Storage precautions

8.2.1 When storing the LCD modules, avoid exposure to direct sunlight or to the light of fluorescent lamps.

8.2.2 The LCD modules should be stored under the storage temperature range. If the LCD modules will be stored for a long time, the recommend condition is:

Temperature : 0? ~ 40? Relatively humidity: “80%

8.2.3 The LCD modules should be stored in the room without acid, alkali and harmful gas.

8.3 Transportation Precautions

The LCD modules should be no falling and violent shocking during transportation, and also should avoid excessive press, water, damp and sunshine.