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TFT | CHARACTER | UWVD | FSC | SEGMENT | CUSTOM | REPLACEMENT

## TFT Display Module

Part Number

E40RB-FW480-N

### Overview:

- 4.0-inch TFT (58.26x98.1 mm)
- 480 x 800 Resolution
- 3SPI & 18-bit Color @ 60Hz
- 18-bit Color @ 60Hz
- All View
- Transmissive
- No Touch Panel
- 480 NITS
- Controllers: ST7701S
- RoHS Compliant

## Description

This is a color active matrix TFT (Thin Film Transistor) LCD (Liquid Crystal Display) that uses amorphous silicon TFT as a switching device. This model is composed of a transmissive type TFT-LCD Panel, driver circuit and a backlight unit. The resolution of the 4.0" TFT-LCD contains 480(RGB)x800 pixels and can display up to 16.7M colors.

## TFT Features

Low Input Voltage: 3.3V

Display colors: 16.7M colors

TFT Interfaces: 3SPI+16/18/24-bit RGB

General Information Items	Specification	Unit	Note
	Main Panel		
TFT Display area (AA)	51.84 (H) x 86.40(V) (4.0 inch)	mm	-
Driver Element	TFT active matrix	-	-
Display Colors	16.7M	colors	-
Number of pixels	480(RGB)x800	dots	-
TFT Pixel arrangement	RGB vertical stripe	-	-
Pixel pitch	0.108 (H) x 0.108 (V)	mm	-
Viewing angle	ALL	o'clock	-
TFT Controller IC	ST7701S	-	-
LCM Interface	3 SPI + 16/18/14-bit RGB	-	-
Display mode	Transmissive/ Normally Black	-	-
Operating temperature	-20~+70	°C	-
Storage temperature	-30~+80	°C	-

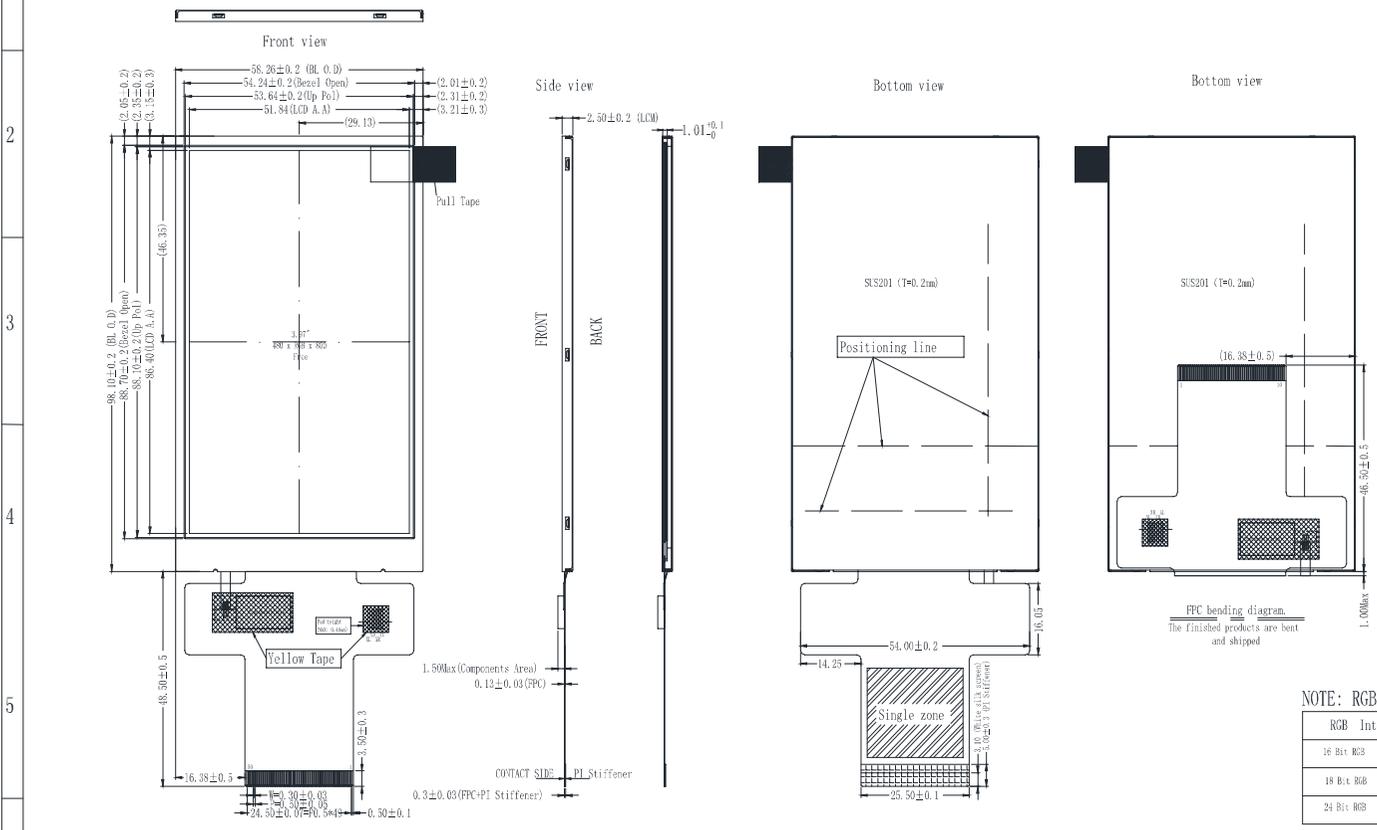
## Mechanical Information

Item		Min	Typ.	Max	Unit	Note
Module size	Height (H)		58.26		mm	-
	Vertical (V)		98.10		mm	-
	Depth (D)		2.50		mm	-

# 1. Outline Dimensions

Note: The opening of top case must be less than LCD POL 0.3mm at least, the LCD V.A is the Recommended opening of Lens.

Rev.	Revision content description	Date
V0	First Issue	2019.09.26



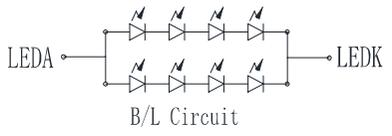
No.	Pin Name
1	VCC
2	XPIN
3	VCC
4	XLIN
5	GND
6	GND
7	VCI
8	IOCC
9	DB23(DB)
10	DB22(DB)
11	DB21(DB)
12	DB20(DB)
13	DB19(DB)
14	DB18(DB)
15	DB17(DB)
16	DB16(DB)
17	DB15(DB)
18	DB14(DB)
19	DB13(DB)
20	DB12(DB)
21	DB11(DB)
22	DB10(DB)
23	DB9(DB)
24	DB8(DB)
25	DB7(DB)
26	DB6(DB)
27	DB5(DB)
28	DB4(DB)
29	DB3(DB)
30	DB2(DB)
31	DB1(DB)
32	DB0(DB)
33	NC
34	NC
35	NC
36	NC
37	RESET
38	CS
39	NC
40	SEL
41	NC
42	PCLK
43	VSIN
44	HSIN
45	DE
46	SIO
47	SH
48	NC
49	LEDA
50	LEDB

NOTE: RGB interface DB Used.

RGB Interface	DB Pin in use
16 Bit RGB interface	DB20-DB16, DB13-DB8, DB4-DB0,
18 Bit RGB interface	DB21-DB16, DB13-DB8, DB5-DB0,
24 Bit RGB interface	DB23-DB0

NOTE: If use d RGB mode must select serial interface!

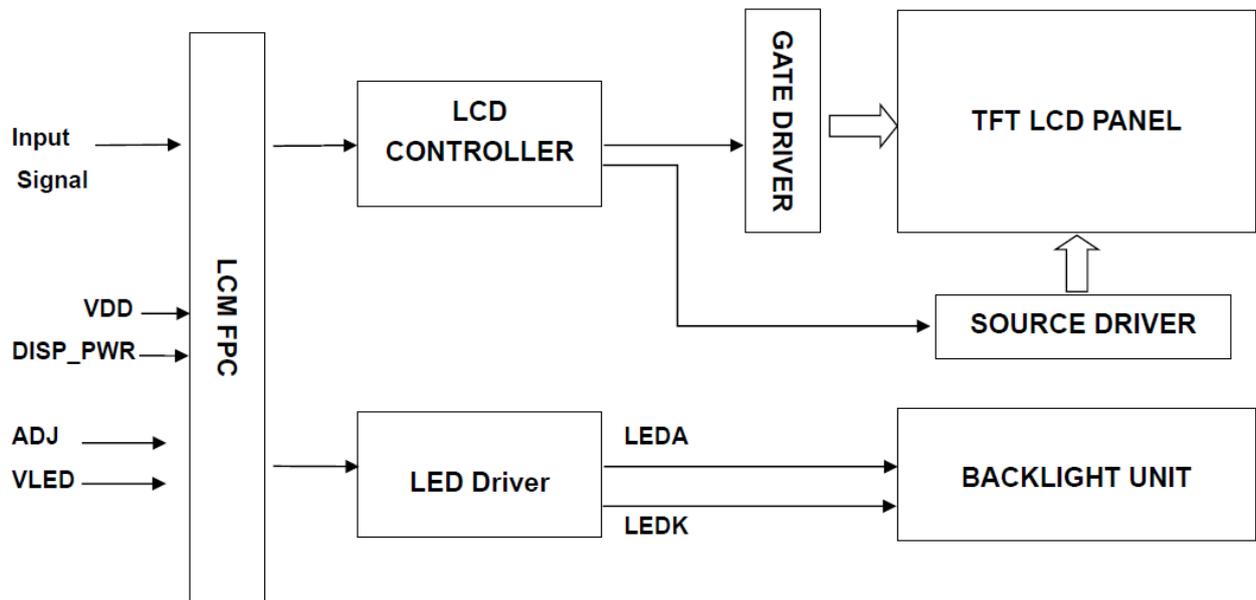
- NOTES:
1. DISPLAY TYPE: 4.0"IPS, TFT-LCD, 16.7M COLORS
  2. DISPLAY MODE: NORMALLY BLACK/Free
  3. VIEWING DIRECTION: Free
  4. LCM DRIVER IC: ST7701S (COG)  
LCM Interface: RGB
  5. VDD/VCI: 2.8-3.3V (TYP), IOVCC: 1.8-3.3V (REF IC D.S)
  6. OPERATING TEMP: -20° C TO 70° C  
STORAGE TEMP: -30° C TO 80° C
  7. BACK LIGHT: White LED, 8pcs LED, 12.8V, 40mA
  8. RoHS COMPLIANT.



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		PARTS NO. E40RB-FW480-N	
TOLERANCE UNLESS OTHERWISE SPECIFIED	X.X±0.3	Drawn	Unit
	X.XX±0.2	Checked	mm
Scale 1:1		Approve	Page 1/1

## 2. Block Diagram



### 3. Input TFT Terminal Pin Assignment

Recommended Connector: FH12S-50S-0.5SH(55)

NO.	Symbol	Description	I/O
1	XR(NC)	Touch panel right glass terminal	A/D
2	YD(NC)	Touch panel bottom film terminal	A/D
3	XL(NC)	Touch panel left glass terminal	A/D
4	YU(NC)	Touch panel top film terminal	A/D
5	GND	Ground	P
6	GND	Ground	P
7	VCI	Supply voltage (3.3V)	P
8	IOVCC	I/O power supply	P
9-32	DB23-DB0	24-bit parallel data bus for RGB interface	I/O
33-36	NC	--	-
37	RESET	External reset input. Initializes the chip with a low input. Execute a power on reset after supply power.	I
38	CS	Chip select signal. Low: The chip is selected and accessible. High: The chip is not selected and not accessible. Fix to IOVCC or GND when not used.	I
39	NC	--	-
40	SCL	Serial clock for the SPI interface. Fix to IOVCC or GND when not used.	-
41	NC	--	-
42	PCLK	Dot clock signal for RGB interface operation. Fix to IOVCC or GND when not used.	I
43	VSYNC	Frame synchronizing signal for RGB interface. Fix to IOVCC or GND when not used.	I
44	HSYNC	Line synchronizing signal for RGB interface. Fix to IOVCC or GND when not used.	I
45	DE	Data enable signal for RGB interface. Low: Access enabled. High: access inhibited. Fix to IOVCC or GND when not used.	I
46	SDO	Serial data output pin for the SPI interface. Leave open when not used.	O
47	SDI	Serial data input bidirectional pin for the SPI interface. Pin to GND when not used.	I
48	NC	--	-
49	LEDA	Anode pin of the backlight	P
50	LEDK	Cathode pin of the backlight	P

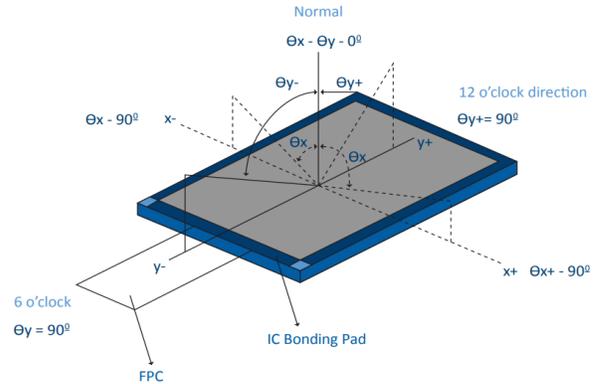
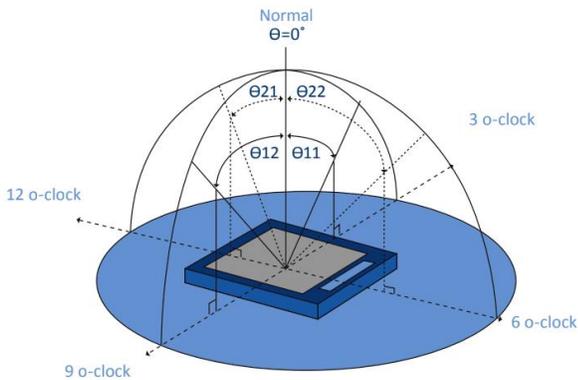
## 4. LCD Optical Characteristics

### 4.1 Optical Specifications

Item	Symbol	Condition	Min	Typ.	Max	Unit	Note
Color Gamut	S%		56	61	--	%	(3)
Contrast Ratio	CR		720	900	--	%	(2)
Response Time	Rising	TR	--	16	21	ms	(4)
	Falling	TF	--	19	24	ms	
Color Filter Chromaticity	White	$W_x$	Normal viewing angle $\theta=0$	0.2733	0.3133	0.3533	(5)(6)
		$W_y$		0.3055	0.3455	0.3855	
	Red	$R_x$		0.5867	0.6267	0.6667	
		$R_y$		0.3087	0.3487	0.3887	
	Green	$G_x$		0.2871	0.3271	0.3671	
		$G_y$		0.5347	0.5747	0.6147	
	Blue	$B_x$		0.1081	0.1481	0.1881	
		$B_y$		0.0246	0.0646	0.1046	
Viewing Angle	Hor.	$\theta_L$	$CR \geq 10$	--	80	--	degree
		$\theta_R$		--	80	--	
	Ver.	$\theta_T$		--	80	--	
		$\theta_B$		--	80	--	
Option View Direction			ALL				(1)

### Optical Specification Reference Notes:

(1) Definition of Viewing Angle: The viewing angle is the angle at which the contrast ratio is greater than 10. The viewing angles are determined for the horizontal or 3,9 o'clock direction and the vertical or 6,12 o'clock direction with respect to the optical axis which is normal to the LCD surface.

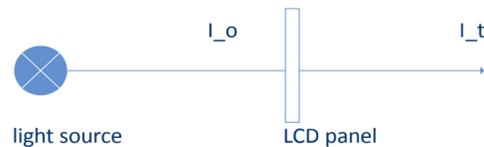


(2) Definition of Contrast Ratio (Cr): measured at the center point of panel. The contrast ratio (Cr) measured on a module, is the ratio between the luminance (Lw) in a full white area (R=G=B=1) and the luminance (Ld) in a dark area (R=G=B=0).

$$Cr = \frac{Lw}{Ld}$$

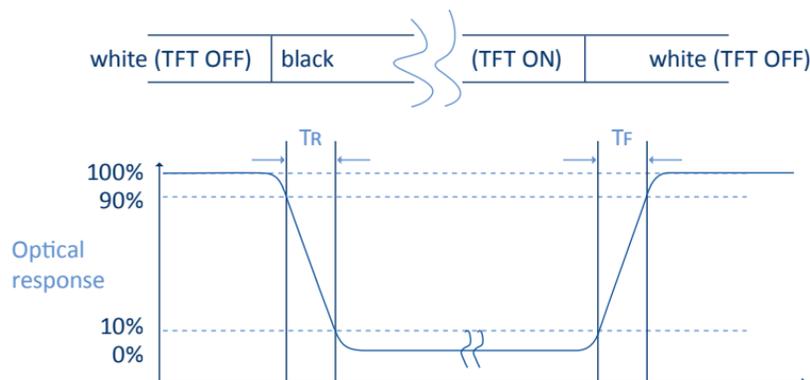
(3) Definition of transmittance (T%): The transmittance of the panel including the polarizers is measured with electrical driving. The equation for transmittance Tr is:

$$Tr = \frac{It}{Io} \times 100\%$$



Io = the brightness of the light source.  
 It = the brightness after panel transmission

(4) Definition of Response Time (Tr, Tf): The rise time 'Tr' is defined as the time for luminance to change from 90% to 10% as a result of a change of the electrical condition. The fall time 'Tf' is defined as the time for luminance to change from 10% to 90% as a result of a change of the electrical condition.



(5) Definition of Color Gamut:

Measuring machine CFT-01. NTSC's Primaries:  $R(x,y,Y), G(x,y,Y), B(x,y,Y)$ . FPM520 of Westar Display Technologies, INC., which utilized SR-3 for Chromaticity and BM-5A for other optical characteristics. The color chromaticity shall be calculated from the spectral data measured with all pixels first in red, green, blue and white. Measurements shall be made at the center of the panel.

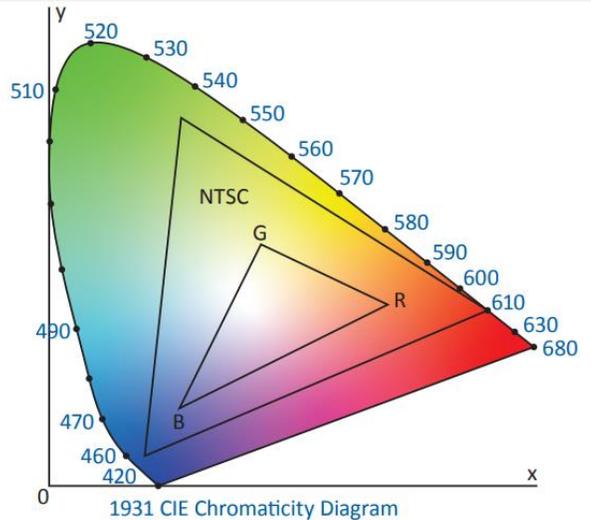
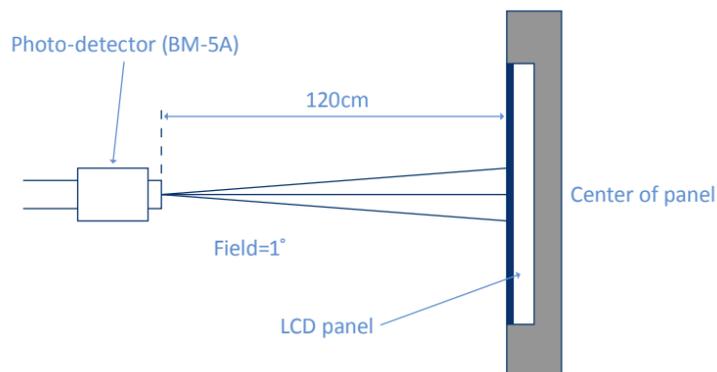
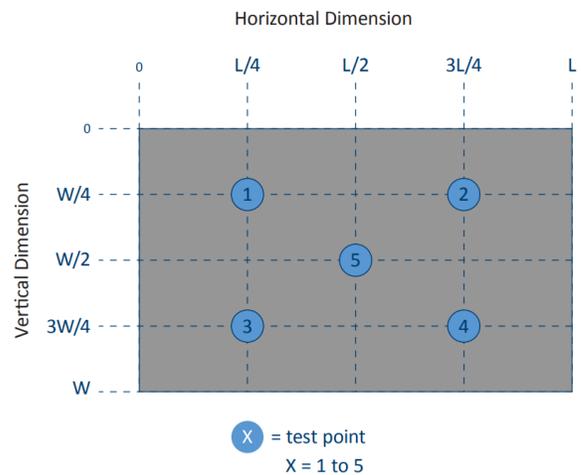
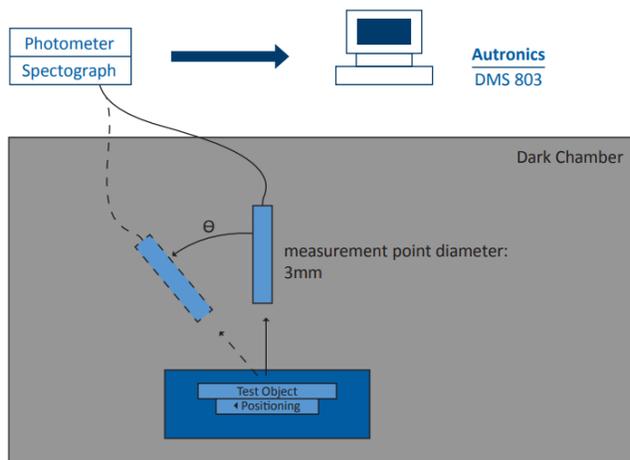


Fig. 1931 CIE chromacity diagram

$$\text{Color gamut: } S = \frac{\text{Area of RGB triangle}}{\text{Area of NTSC triangle}} \times 100\%$$

(6) Definition of Optical Measurement Setup:

The LCD module should be stabilized at a given temperature for 20 minutes to avoid abrupt temperature change during measuring. In order to stabilize the luminance, the measurement should be executed after lighting backlight for 20 minutes.



## 5. TFT Electrical Characteristics

### 5.1 Absolute Maximum Rating (Ta=25 °C, VSS=0V)

Characteristics	Symbol	Min	Max	Unit
Digital Supply Voltage	VDD	-0.3	4.6	V
Digital Interface Supply Voltage	IOVCC	-0.3	4.6	V
Operating Temperature	TOP	-20	+70	°C
Storage Temperature	TST	-30	+80	°C

*NOTE: If the absolute maximum rating of the above parameters is exceeded, even momentarily, the quality of the product may be degraded. Absolute maximum ratings specify the values which the product may be physically damaged if exceeded. Be sure to use the product within the range of the absolute maximum ratings.*

### 5.2 DC Electrical Characteristics

Characteristics	Symbol	Min	Typ.	Max	Unit	Note
Digital Supply Voltage	VDD	2.5	3.3	3.6	V	
Digital Interface Supply Voltage	IOVCC	1.65	1.8	3.6	V	
Normal Mode Current Consumption	IDD	--	28	56	mA	
Level Input Voltage	VIH	0.7IOVCC	--	IOVCC	V	
	VIL	GND	--	0.3IOVCC	V	
Level Output Voltage	VOH	0.8IOVCC	--	IOVCC	V	
	VOL	GND	--	0.2IOVCC	V	

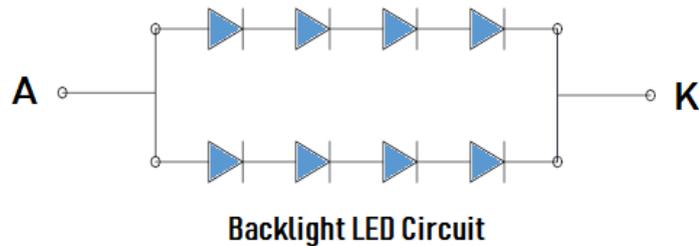
### 5.3 LED Backlight Characteristics

The backlight system is edge lighting type with 8 chips

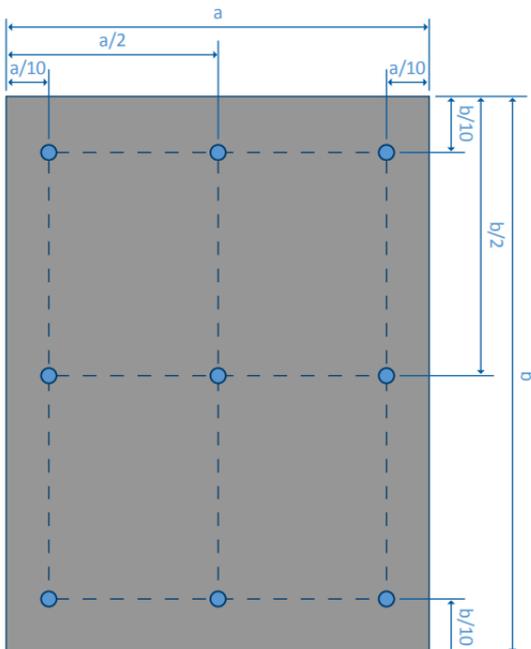
Item	Symbol	Min	Typ.	Max	Unit	Note
Forward Current	I <sub>F</sub>	30	40	--	mA	
Forward Voltage	V <sub>F</sub>	--	12.8	--	V	
LCM Luminance	LV	43	480	--	cd/m <sup>2</sup>	Note 3
LED lifetime	Hr	50000	--	--	hour	Note1 & 2
Uniformity	AV <sub>g</sub>	80	--	--	%	Note 3

Note 1: LED lifetime (Hr) can be defined as the time in which it continues to operate under the condition: Ta=25±3 °C, typical IL value indicated in the above table until the brightness becomes less than 50%.

Note 2: The “LED lifetime” is defined as the module brightness decrease to 50% original brightness at Ta=25°C and IL= 40mA



Note 3: Luminance Uniformity of these 9 points is defined as below:



$$\text{Luminance} = \frac{\text{Total Luminance of 9 points}}{9}$$

$$\text{Uniformity} = \frac{\text{minimum luminance in 9 points(1-9)}}{\text{maximum luminance in 9 points(1-9)}}$$

## 6. AC Characteristic

### 6.1 Parallel RGB Interface Characteristics

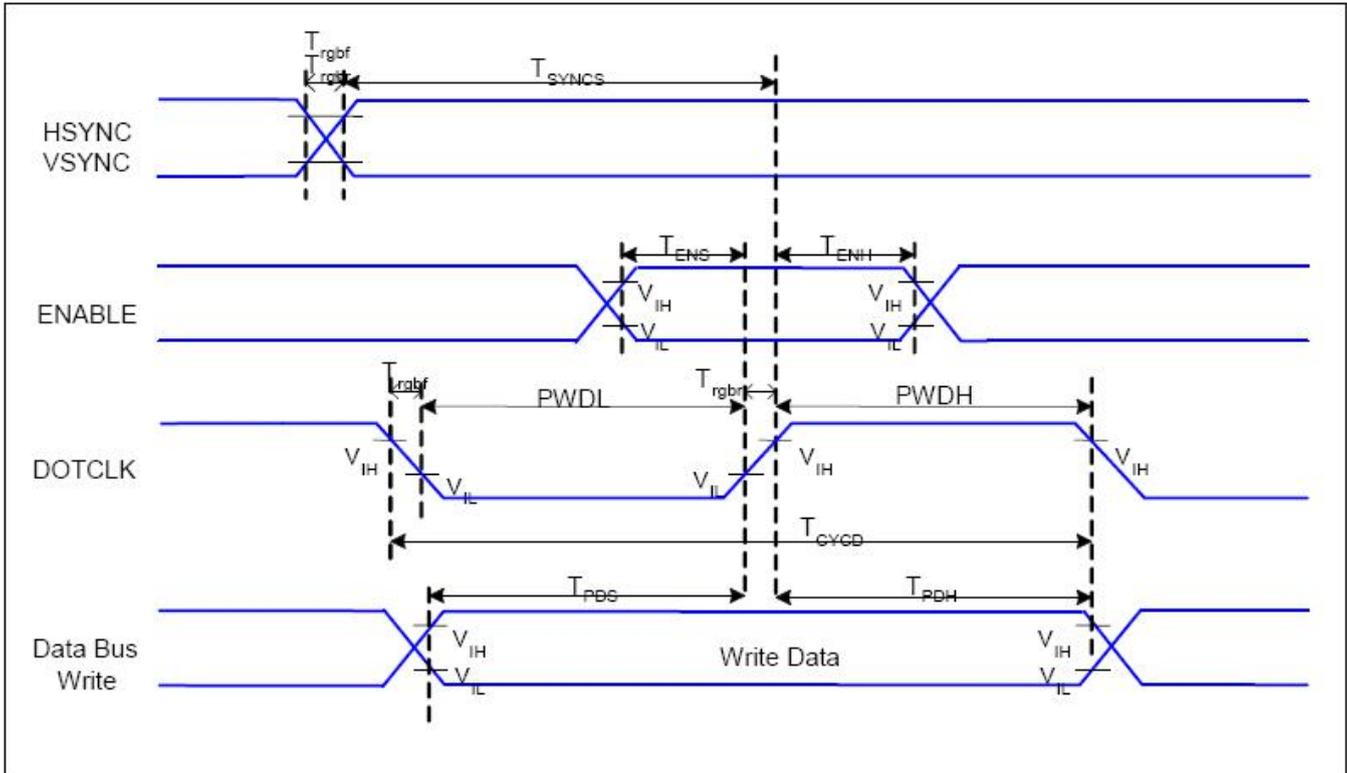


Figure 6.1: Parallel RGB Interface Timing Diagram

Signal	Symbol	Parameter	Min	Max	Unit	Description
HSYNC, VSYNC	$T_{SYNCS}$	VSYSNC, HSYNC Setup Time	5	-	ns	
ENABLE	$T_{ENS}$	Enable Setup Time	5	-	ns	
	$T_{ENH}$	Enable Hold Time	5	-	ns	
DOTCLK	PWDH	DOTCLK High-level Pulse Width	15	-	ns	
	PWDL	DOTCLK Low-level Pulse Width	15	-	ns	
	$T_{CYCD}$	DOTCLK Cycle Time	33	-	ns	
	$T_{RGHR}, T_{RGHF}$	DOTCLK Rise/Fall Time	-	15	ns	
DE	$T_{PDS}$	PD Data Setup Time	5	-	ns	
	$T_{PDH}$	PD Data Hold Time	5	-	ns	

Table 6.1: Parallel RGB Interface Timing Characteristics

## 6.2 Display Serial Interface Characteristics (3-line SPI system)

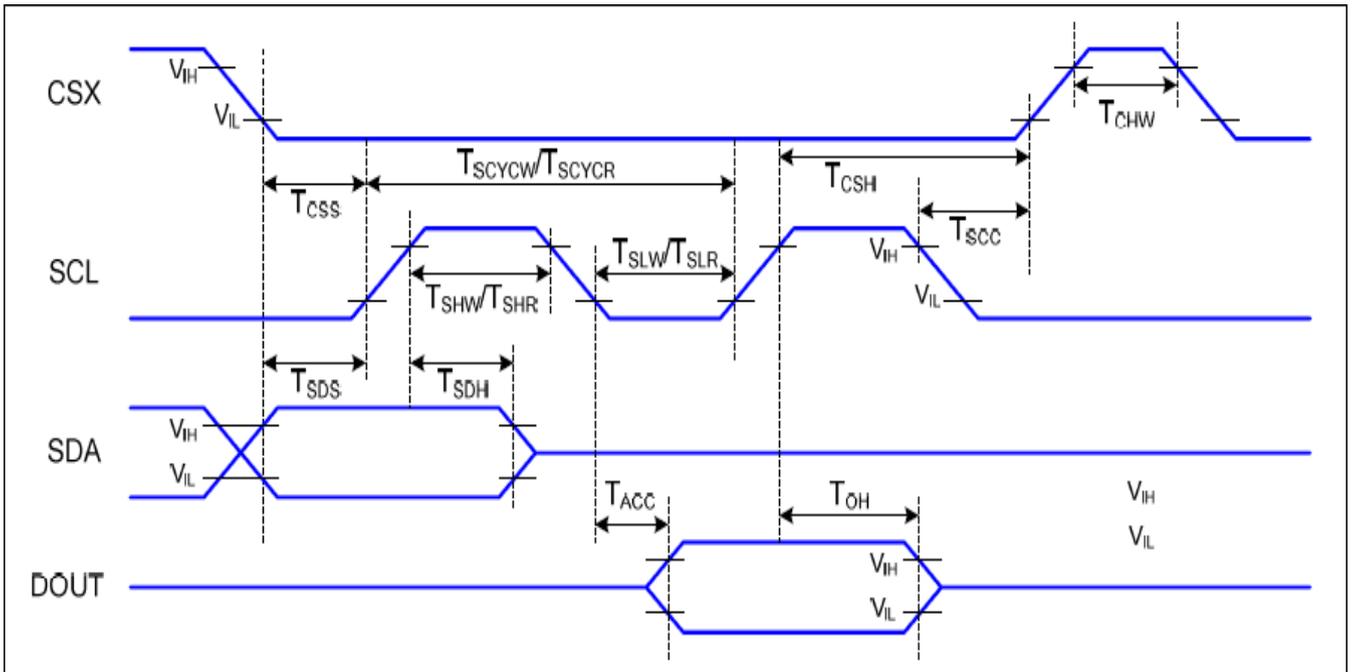


Figure 6.2: Serial Interface 3-SPI Timing Diagram

$IOVCC=1.8V, VCI=2.8V, Ta=-30 \text{ to } 70 \text{ } ^\circ\text{C}$

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)	60		ns	
	$T_{CHW}$	Chip select "H" pulse width	40		ns	
SCL	$T_{SCYCW}$	Serial clock cycle (write)	66		ns	
	$T_{SHW}$	SCL "H" pulse width (write)	15		ns	
	$T_{SLW}$	SCL "L" width (write)	15		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	10		ns	
	$T_{SDH}$	Data hold time	10		ns	

Table 6.2: 3-line Serial Interface Timing Characteristics

Note: The rising time and falling time ( $T_r, T_f$ ) of input signal are specified at 15 ns or less. Logic high and low levels are specified as 30% and 70% of  $V_{DDI}$  for Input signals

### 6.3 Reset Timing

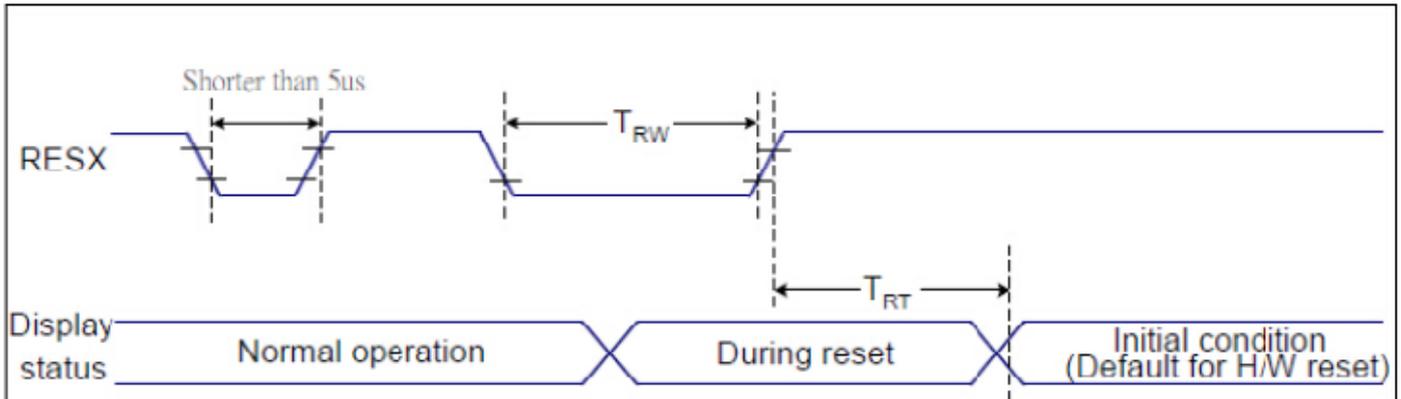


Figure 6.3: Reset Timing Diagram

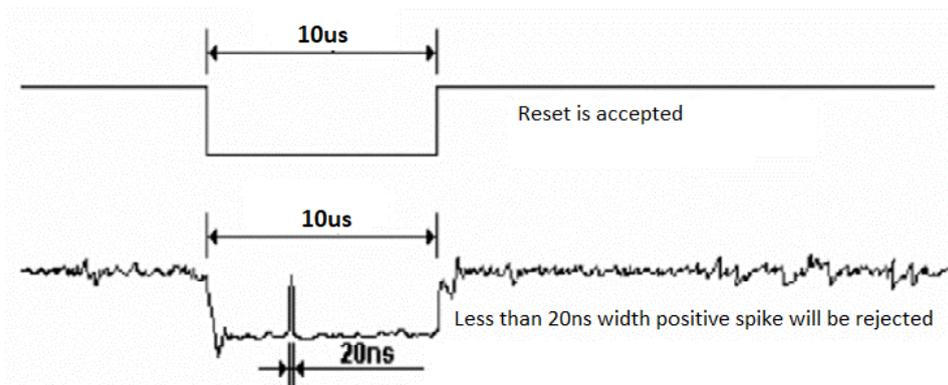
Related Pins	Symbol	Parameter	Min	Max	Unit
RESX	TRW	Reset pulse duration	10	-	us
	TRT	Reset cancel	-	5 (Note 1,5)	ms
				120 (Note 1, 6, 7)	ms

Notes:

1. The reset cancel includes also required time for loading ID bytes, VCOM setting and other settings from NVM (or similar device) to registers. This loading is done every time when there is HW reset cancel time (tRT) within 5ms after a rising edge of RESX.
2. Spike due to an electrostatic discharge on RESX line does not because irregular system reset according to the table below:

RESX Pulse	Action
Shorter than 5us	Reset Rejected
Longer than 9us	Reset
Between 5us and 9 us	Reset starts

3. During the resetting period, the display will be blanked (the display is entering blanking sequence, which maximum time is 120ms, when reset starts in Sleep Out mode. The display remains the blank state in Sleep in mode) and then return to Default condition for Hardware Reset.
4. Spike Rejection also applies during a valid reset pulse as shown below:



5. When Reset applied during Sleep In Mode.
6. When Reset applied during Sleep Out Mode.
7. It is necessary to wait 5ms after releasing RESX before sending commands. Also Sleep Out command cannot be sent for 120ms.

## 7. Cautions and Handling Precautions

### 7.1 Handling and Operating the Module

1. When the module is assembled, it should be attached to the system firmly. Do not warp or twist the module during assembly work.
2. Protect the module from physical shock or any force. In addition to damage, this may cause improper operation or damage to the module and back-light unit.
3. Note that polarizer is very fragile and could be easily damaged. Do not press or scratch the surface.
4. Do not allow drops of water or chemicals to remain on the display surface. If you have the droplets for a long time, staining and discoloration may occur.
5. If the surface of the polarizer is dirty, clean it using some absorbent cotton or soft cloth.
6. The desirable cleaners are water, IPA (Isopropyl Alcohol) or Hexane. Do not use ketene type materials (ex. Acetone), Ethyl alcohol, Toluene, Ethyl acid or Methyl chloride. It might permanent damage to the polarizer due to chemical reaction.
7. If the liquid crystal material leaks from the panel, it should be kept away from the eyes or mouth. In case of contact with hands, legs, or clothes, it must be washed away thoroughly with soap.
8. Protect the module from static; it may cause damage to the CMOS ICs.
9. Use fingerstalls with soft gloves in order to keep display clean during the incoming inspection and assembly process.
10. Do not disassemble the module.
11. Protection film for polarizer on the module shall be slowly peeled off just before use so that the electrostatic charge can be minimized.
12. Pins of I/F connector shall not be touched directly with bare hands.
13. Do not connect, disconnect the module in the "Power ON" condition.
14. Power supply should always be turned on/off by the item Power On Sequence & Power Off Sequence.

### 7.2 Storage and Transportation

1. Do not leave the panel in high temperature, and high humidity for a long time. It is highly recommended to store the module with temperature from 0 to 35 °C and relative humidity of less than 70%
2. Do not store the TFT-LCD module in direct sunlight.
3. The module shall be stored in a dark place. When storing the modules for a long time, be sure to adopt effective measures for protecting the modules from strong ultraviolet radiation, sunlight, or fluorescent light.
4. It is recommended that the modules should be stored under a condition where no condensation is allowed. Formation of dewdrops may cause an abnormal operation or a failure of the module. In particular, the greatest possible care should be taken to prevent any module from being operated where condensation has occurred inside.
5. This panel has its circuitry FPC on the bottom side and should be handled carefully in order not to be stressed.