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Ph. 480-503-4295 | [NOPP@FocusLCD.com](mailto:NOPP@FocusLCD.com)

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

## TFT Display Module

Part Number  
E50RC-FS300-N

### Overview:

- 5.0-inch TFT: (132.21x136.53mm)
- 1080(RGB)x1080 pixels
- 1/2/3/4-Lane MIPI/DSI Interface
- Special Temperature Range
- All View
- Transmissive
- No Touch Panel
- 300 NITS
- Controller: HX8399C
- 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 5.0" TFT-LCD contains 1080x1080 pixels and can display up to 16.7M colors.

## TFT Features

Display Colors: 16.7M

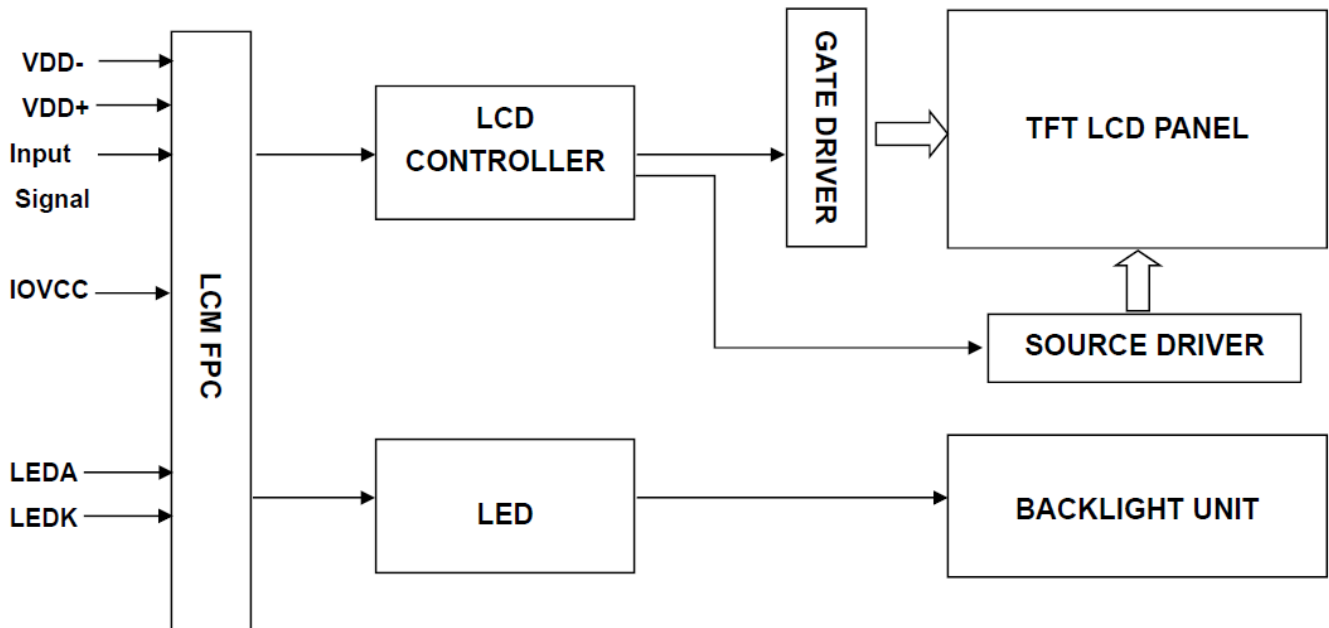
TFT Interfaces: 1/2/3/4-lane MIPI

General Information Items	Specification	Unit	Note
	Main Panel		
TFT Display area (AA)	127.008 (H) x 127.008 (V) (3.5 inch)	mm	-
Driver element	TFT active matrix	-	-
Display colors	16.7M	colors	-
Number of pixels	1080(RGB)x1080	dots	-
TFT Pixel arrangement	RGB vertical stripe	-	-
Pixel pitch	0.1176 (H) x 0.1176 (V)	mm	-
Viewing angle	ALL	o'clock	-
TFT Controller IC	HX8399	-	-
LCM Interface	1/2/3/4-Lane MIPI	-	-
Display mode	Transmissive/ Normally Black	-	-
Operating temperature	-20~+60	°C	-
Storage temperature	-30~+75	°C	-

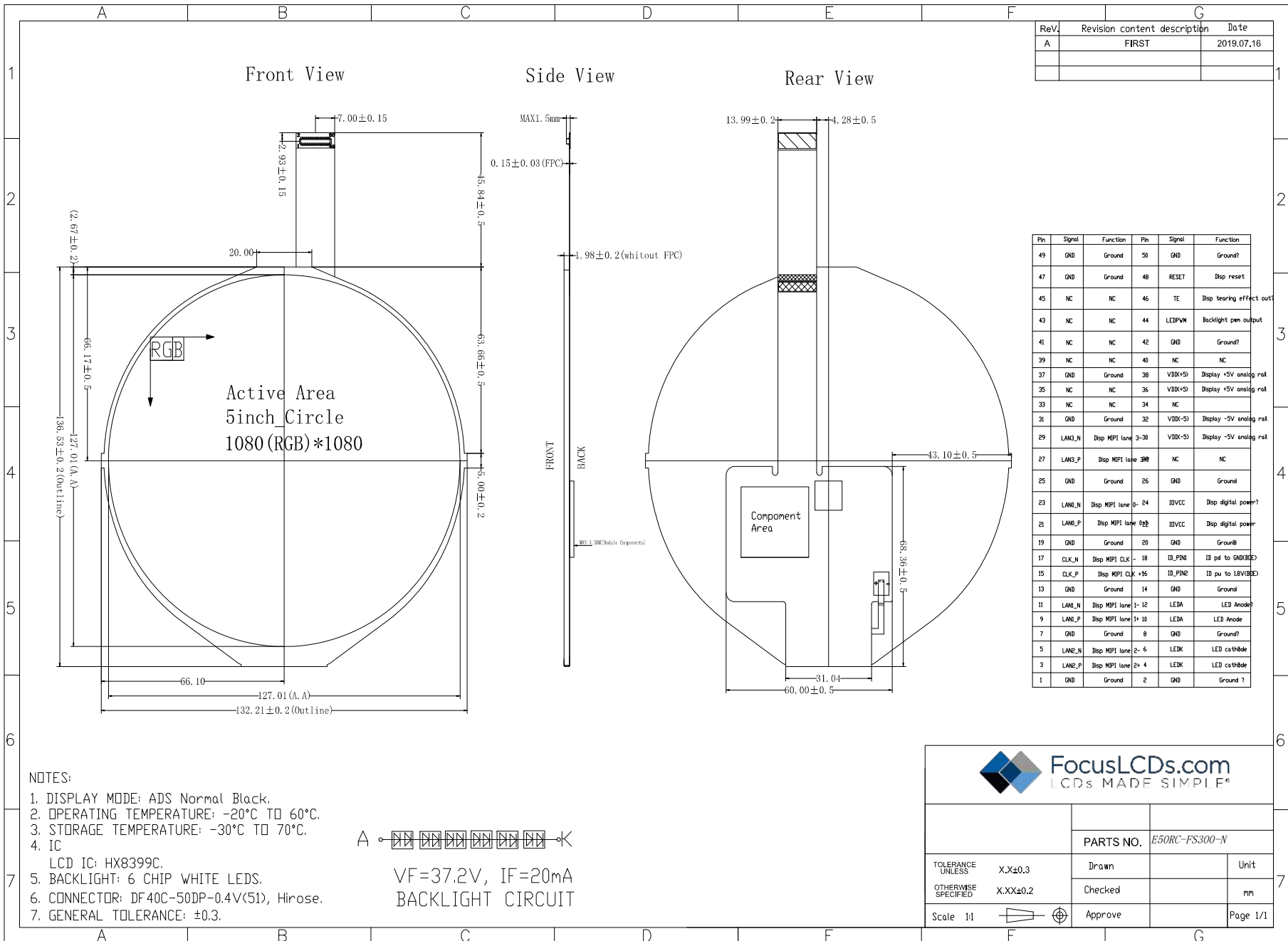
## Mechanical Information

Item		Min	Typ.	Max	Unit	Note
Module size	Height (H)		132.208		mm	-
	Vertical (V)		136.531		mm	-
	Depth (D)		1.98		mm	-
Weight			70		g	-

## 1. Block Diagram



## 2. Outline Dimensions



### 3. Input Terminal Pin Assignment

Recommended Connector: DF40C-50DP-0.4V(51)

NO.	Symbol	Description	I/O
1	GND	Ground	P
2	GND	Ground	P
3	LAN2_P	Display MIPI lane 2+	I
4	LEDK	LED cathode	P
5	LAN2_N	Display MIPI lane 2-	I
6	LEDK	LED cathode	P
7	GND	Ground	P
8	GND	Ground	P
9	LAN1_P	Display MIPI lane 1+	I
10	LEDA	LED anode	P
11	LAN1_N	Display MIPI lane 1-	I
12	LEDA	LED anode	P
13	GND	Ground	P
14	GND	Ground	P
15	CLK_P	Display MIPI clock+	I
16	ID_PIN2	ID pull up to 1.8V (LCM). If not used leave open.	P
17	CLK_N	Display MIPI clock-	I
18	ID_PIN1	ID pull down to GND (LCM). If not used leave open.	P
19	GND	Ground	P
20	GND	Ground	P
21	LAN0_P	Display MIPI lane 0+	I
22	IOVCC	Display digital power (1.8V)	P
23	LAN0_N	Display MIPI lane 0-	I
24	IOVCC	Display digital power (1.8V)	P
25	GND	Ground	P
26	GND	Ground	P
27	LAN3_P	Display MIPI lane 3+	I
28	NC	NC	
29	LAN3_N	Display MIPI lane 3-	I
30	VSN/VDD-	Display -5V analog rail	P
31	GND	Ground	P
32	VSN/VDD-	Display -5V analog rail	P
33	NC	NC	
34	NC	NC	
35	NC	NC	
36	VSP/VDD+	Display +5V analog rail	P
37	GND	Ground	P
38	VSP/VDD+	Display +5V analog rail	P
39	NC	NC	
40	NC	NC	
41	NC	NC	
42	GND	Ground	P
43	NC	NC	
44	LEDPWM	Backlight PWM output. If not used leave open.	O
45	NC	NC	
46	TE	Display tearing effect out. If not used leave open.	O
47	GND	Ground	P
48	RESET	Display reset	I
49	GND	Ground	P
50	GND	Ground	P

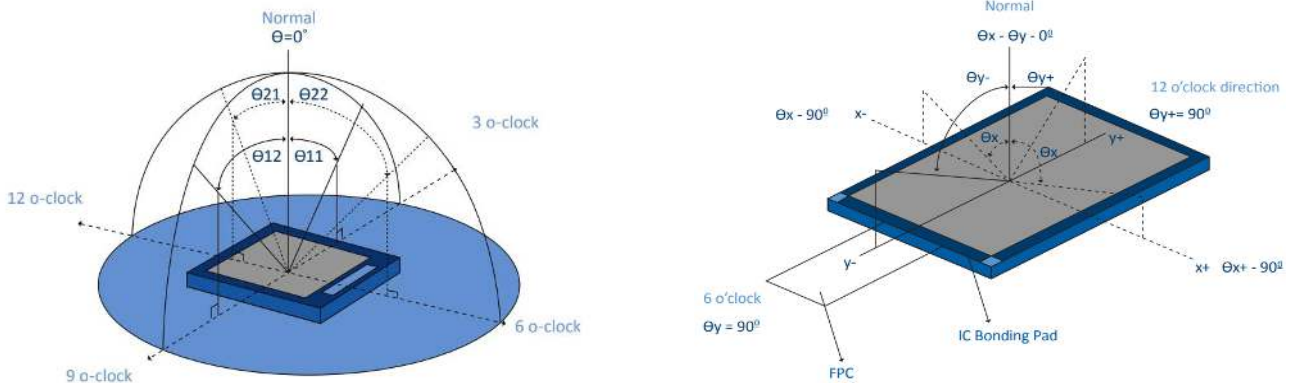
## 4. LCD Optical Characteristics

### 4.1 Optical Specifications

Item	Symbol	Condition	Min	Typ.	Max	Unit	Note	
Contrast Ratio	CR	Normal viewing angle $\theta=0$	800	1200	--	%	(2)	
Response Time	Rising		Tr+Tf	--	--	40	ms	
	Falling							
Color Gamut	S(%)		60	65	--	%	(5)	
Color Filter Chromaticity	White		$W_x$	0.2422	0.2822	0.3222	degree	(5)(6)
			$W_y$	0.2597	0.2957	0.3357		
	Red		$R_x$	0.5938	0.6338	0.6738		
			$R_y$	0.3075	0.3475	0.3875		
	Green		$G_x$	0.2641	0.3041	0.3441		
			$G_y$	0.5093	0.5493	0.5893		
	Blue	$B_x$	0.1064	0.1464	0.1864			
		$B_y$	0.0126	0.0526	0.0926			
Viewing Angle	Hor.	$\Theta_L$	70	80	--	degree	(1)(6)	
		$\Theta_R$	70	80	--			
	Ver.	$\Theta_T$	70	80	--			
		$\Theta_B$	70	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.

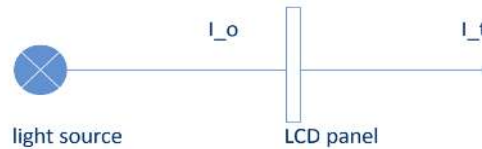


(2) Definition of Contrast Ratio (Cr): measured at the center point of panel. The contrast ratio (Cr) measured on a module, is the ratio between the luminance (Lw) in a full white area (R=G=B=1) and the luminance (Ld) in a dark area (R=G=B=0).

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

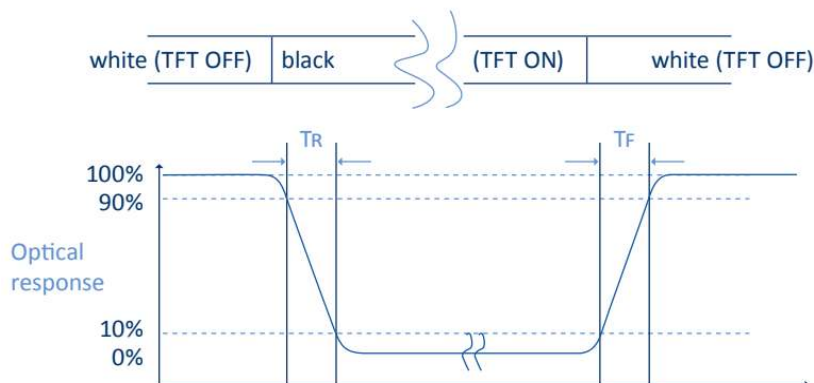
(3) Definition of transmittance (T%): The transmittance of the panel including the polarizers is measured with electrical driving. The equation for transmittance Tr is:

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



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.

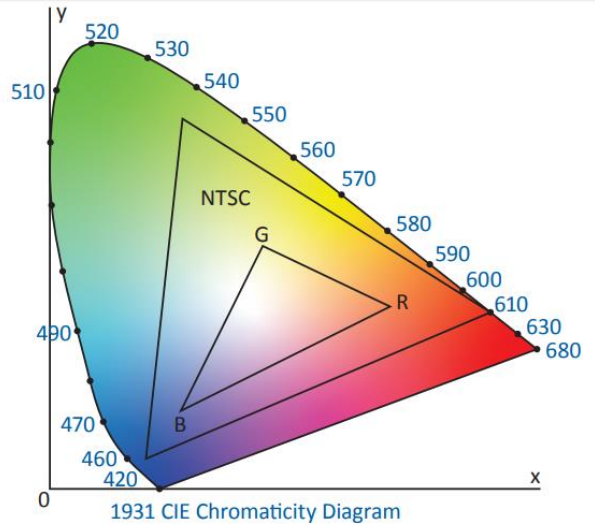
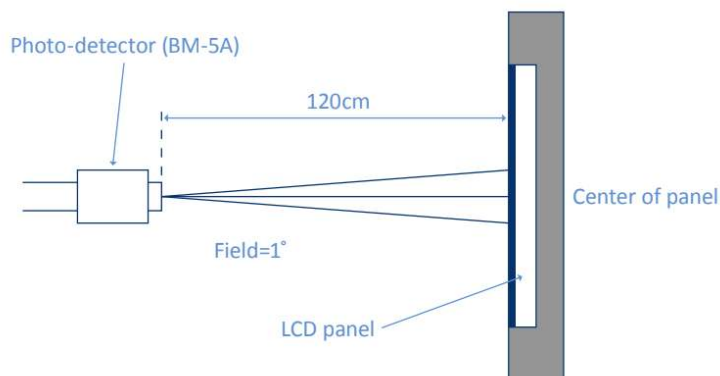
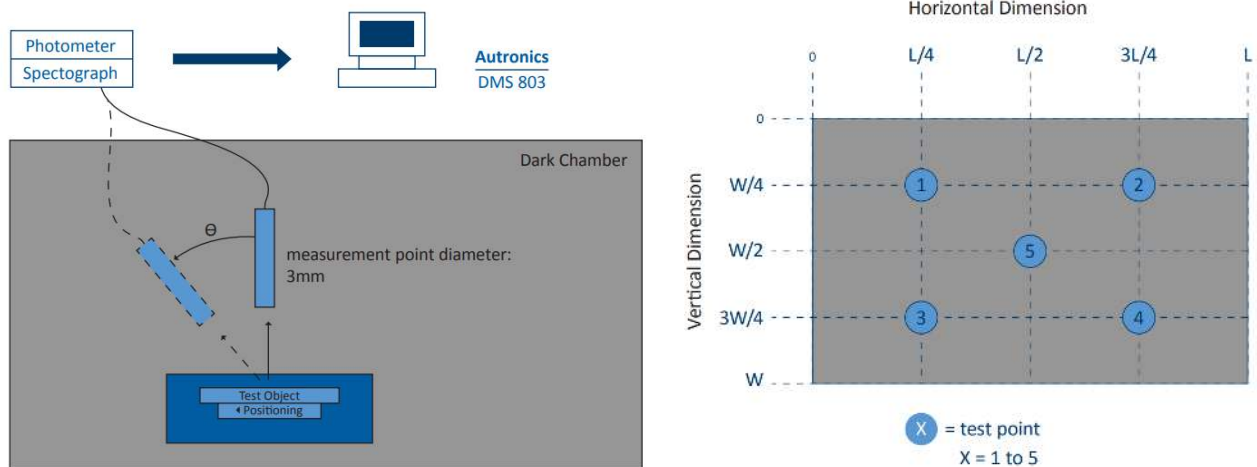


Fig. 1931 CIE chromacity diagram

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

(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
Logic Power Supply Voltage	IOVCC	-0.3	3.6	V
Analog Positive Power Supply	VDD+/VSP	-0.3	6.6	
Analog Negative Power Supply	VDD-/VSN	0	-6.6	V
Operating Temperature	TOP	-20	+60	°C
Storage Temperature	TST	-30	+75	°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
Power Supply Input Voltage	IOVCC	1.65	1.8	3.3	V	
Analog Positive Power Supply	VDD+/VSP	4.8	5.0	6.0	V	
Analog Negative Power Supply	VDD-/VSP	-6.0	-5.0	-4.8		
Normal Mode Current	IOIDD	--	17	34	mA	
Level Input Voltage	VIL	0	--	0.3*IOVCC	V	
Level Output Voltage	VIH	0.7*IOVCC	--	IOVCC	V	

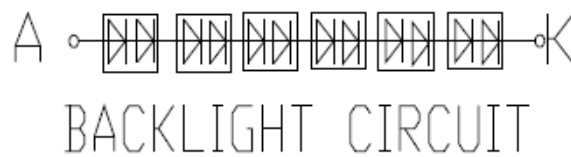
### 5.3 LED Backlight Characteristics

The backlight system is edge lighting type with 12 chips

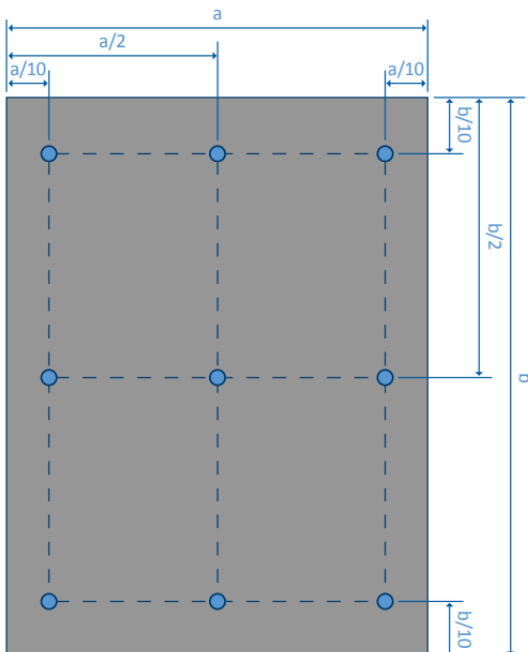
Item	Symbol	Min	Typ.	Max	Unit	Note
Forward Current	I <sub>F</sub>	15	20	--	mA	
Forward Voltage	V <sub>F</sub>	--	37.2	38.4	V	
LCM Luminance	LV	250	300	--	cd/m <sup>2</sup>	Note 3
LED lifetime	Hr	--	30000	--	hour	Note1 & 2
Uniformity	AVg	70	--	--	%	Note 3

Note 1: LED lifetime (Hr) can be defined as the time in which it continues to operate under the condition: T<sub>a</sub>=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 T<sub>a</sub>=25°C and I<sub>L</sub> = 20mA. The LED lifetime could be decreased if operating I<sub>L</sub> is larger than 20mA. The constant current driving method is suggested.



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

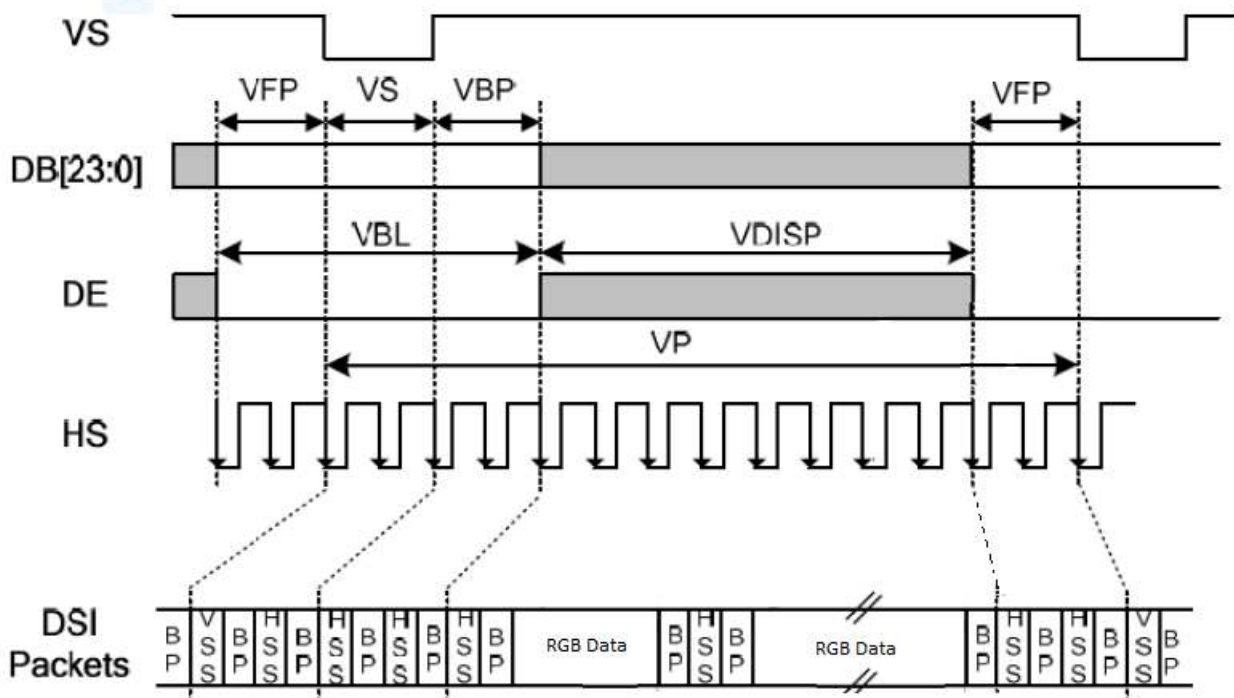


$$\text{Luminance} = \frac{\text{(Total Luminance of 9 points)}}{9}$$

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

## 6. Signal Timing Specifications

### 6.1 Vertical Timing

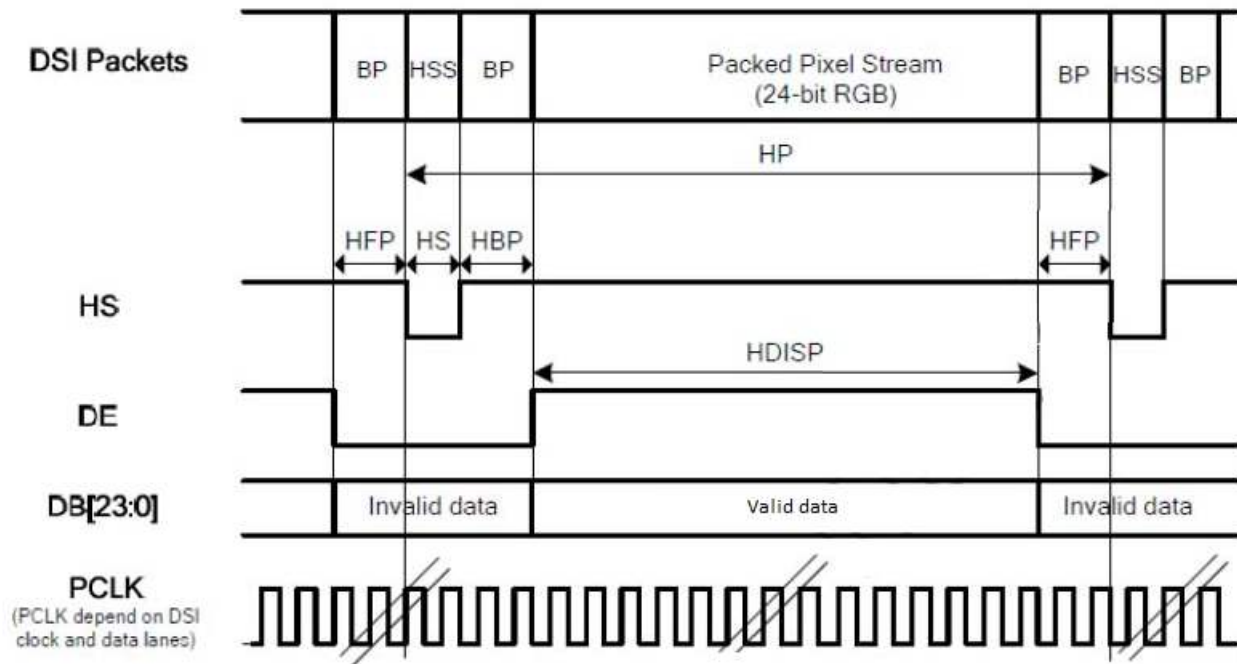


Vertical Resolution=528+8xNL (VSSA=0V, VDD1=1.8V, VDD3=2.8V, TA=25C)

Parameter	Symbol	Condition	Min	Typ	Max	Unit
Vertical cycle	VP	-	534+8xNL	-	-	Line
Vertical low pulse width	VS	-	2	-	note (1)	Line
Vertical front porch	VFP	-	2	-	-	Line
Vertical back porch	VBP	-	2	-	note (1)	Line
Vertical data start point	-	VS+VBP	4	-	note (1)	Line
Vertical blanking period	VBL	VS+VBP+VFP	6	-	-	Line
Vertical active area	-	VDISP	-	528+8xNL	-	Line
Vertical refresh rate	VRR	-	-	60	-	Hz

Note (1): The VS and VBP pulse width are related to GSP and GCK timing. The GSP and GCK must be set at corresponding positions for LCD normal display.

## 6.2 Horizontal Timing



Horizontal Resolution =  $H\_RES(1080/1024/960/800/720)$  ( $VSSA=0V$ ,  $VDD1=1.8V$ ,  $VDD3=HS\_VCC=2.8V$ ,  $TA=25C$ )

Parameter	Symbol	Condition	Min	Typ	Max	Unit
HS cycle	HP	-	$H\_RES+66$	-	-	DCK
HS low pulse width	HS	-	25	-	-	DCK
Horizontal back porch	HBP	-	25	-	-	DCK
Horizontal front porch	HFP	-	16	-	-	DCK
Horizontal data start point	-	$HS+HBP$	50 Note(1)	-	-	DCK
Horizontal blanking period	HBLK	$HS+HBP+HFP$	66	-	-	DCK
Horizontal active area	HDISP		-	$H\_RES$	-	DCK

### 6.3 Reset Timing

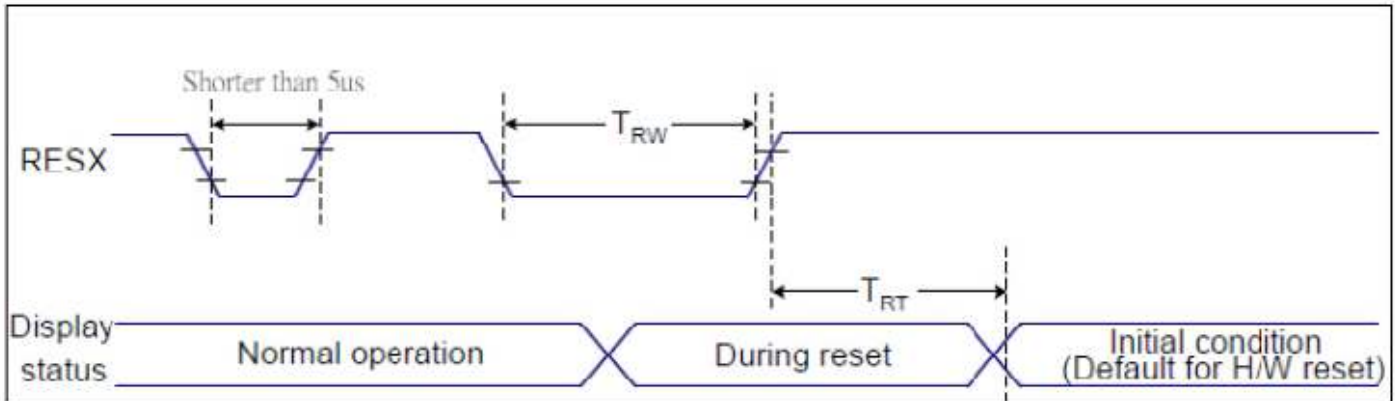


Figure 6.3: Reset Timing Diagram

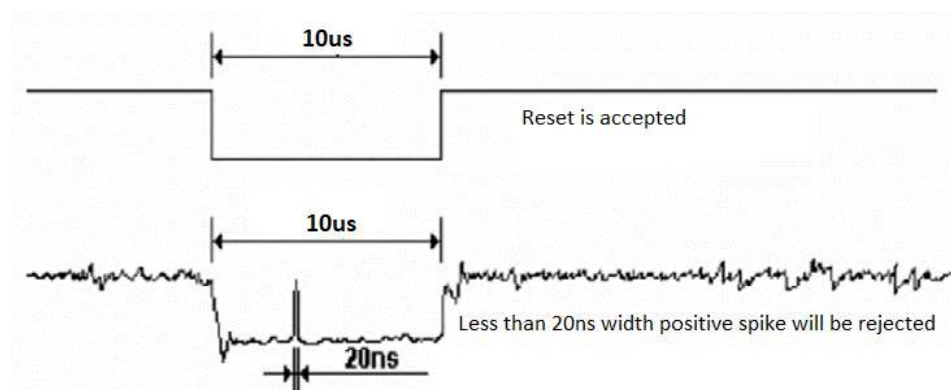
Related Pins	Symbol	Parameter	Min	Max	Unit
RESX	TRW	Reset pulse duration	10	-	us
	TRT	Reset cancel	-	5 (Note 1,5)	ms
				120 (Note 1, 6, 7)	ms

Notes:

- 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.
- 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

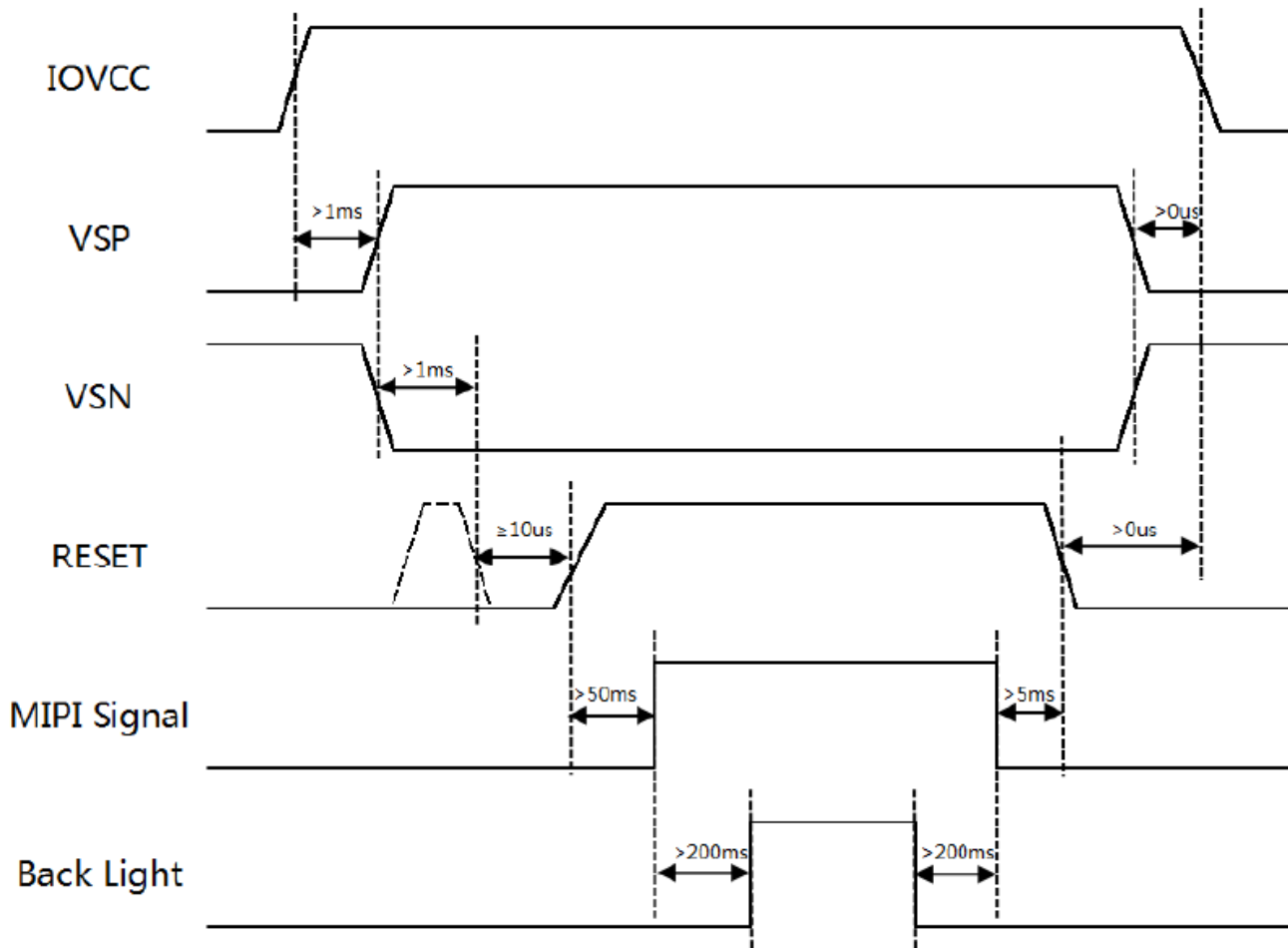
- During the resetting period, the display will be blanked (the display is entering blanking sequence, which maximum time is 120ms, when reset starts in Sleep Out mode. The display remains the blank state in Sleep in mode) and then return to Default condition for Hardware Reset.
- Spike Rejection also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



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

## 6.4 Power On/Off Sequence

### Power on/off Sequence



## 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.