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

## TFT Display Module

Part Number

E40RB-FW600-N

### Overview:

- 4.0-inch TFT (58.26x98.1mm)
- 480(RGB)x800 pixels
- 16/18/24-bit RGB Interface
- 3-wire SPI Interface
- Wide Temp
- Transmissive/ Normally Black
- No Touch Panel
- 600 NITS
- Controller: ILI9806E
- 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 backlight unit. The resolution of the 4.0" TFT-LCD contains 480x800 pixels and can display up to 65K/262K/16.7M colors.

## Features

Low Input Voltage: 3.3V (TYP)

Display Colors of TFT LCD: 65K/262K/16.7M colors

TFT Interfaces: 3-wire SPI

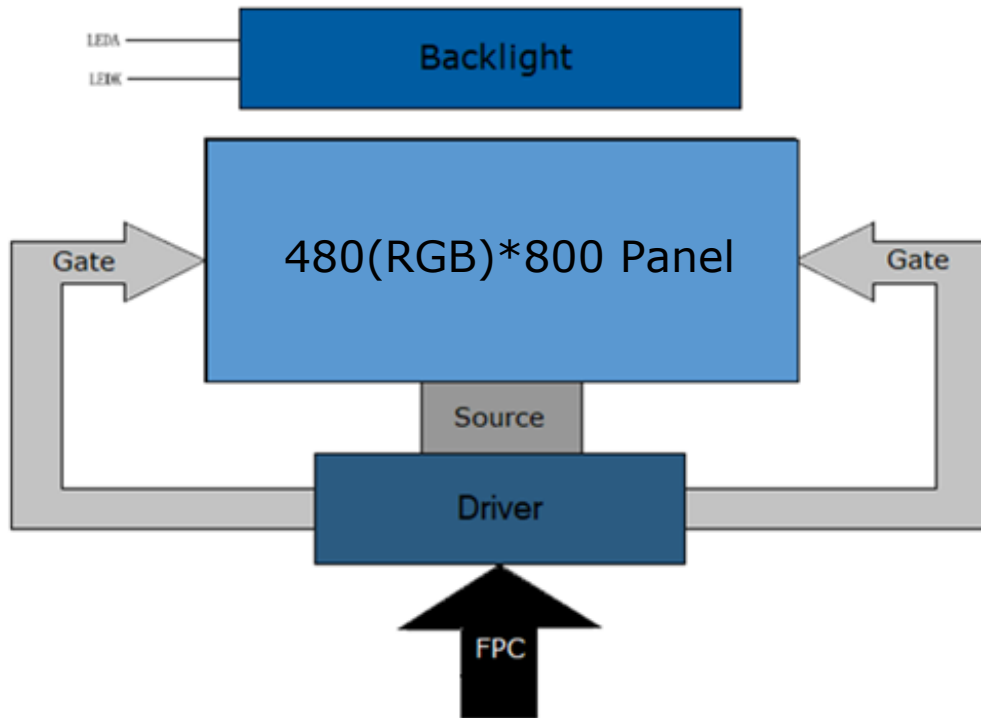
16/18/24-bit RGB

General Information Items	Specification	Unit	Note
	Main Panel		
TFT Display area (AA)	51.84 (H) x 86.4 (V) (4.0 inch)	mm	-
Driver element	TFT active matrix	-	-
Display colors	65K/262K/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	-
CTP Driver IC	ILI9806E	-	-
Display mode	Transmissive/ Normally Black	-	-
Operating temperature	-20~+70	°C	-
Storage temperature	-30~+80	°C	-

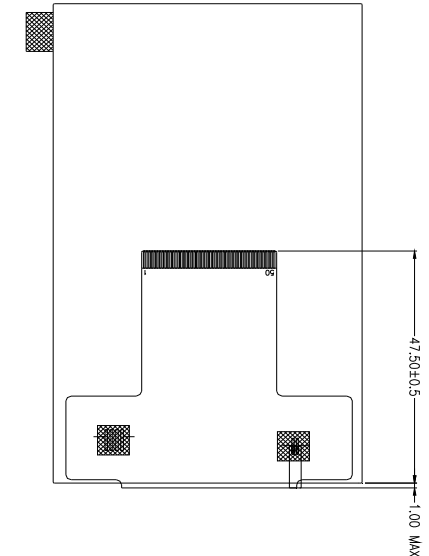
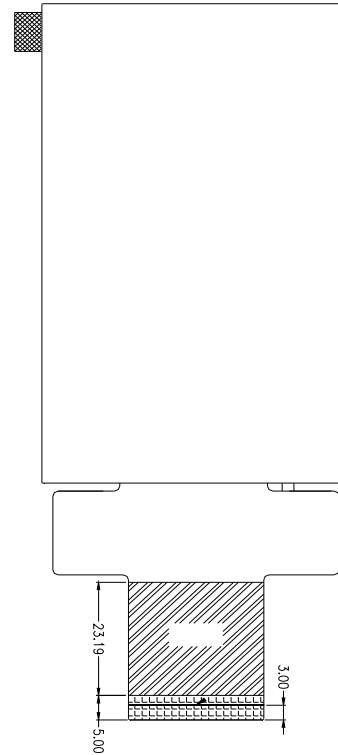
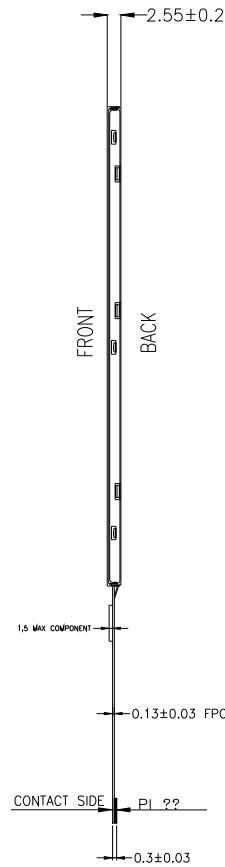
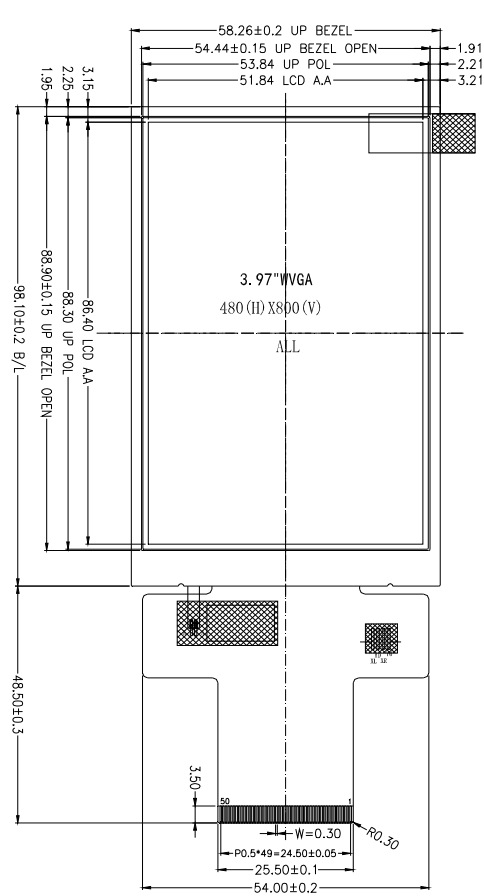
## Mechanical Information

Item		Min	Typ.	Max	Unit	Note
Module size	Height (H)		58.26		mm	-
	Vertical (V)		98.10		mm	-
	Depth (D)		2.55		mm	-
Weight			TBD		g	-

## 1. Block Diagram



## 2. Outline Dimensions



NO.	Pin Name
1	YU(NC)
2	XR(NC)
3	YD(NC)
4	XL(NC)
5	GND
6	GND
7	VCI
8	IOVCC
9	DB23(R7)
10	DB22(R6)
11	DB21(R5)
12	DB20(R4)
13	DB19(R3)
14	DB18(R2)
15	DB17(R1)
16	DB16(R0)
17	DB15(G7)
18	DB14(G6)
19	DB13(G5)
20	DB12(G4)
21	DB11(G3)
22	DB10(G2)
23	DB9(G1)
24	DB8(G0)
25	DB7(B7)
26	DB6(B6)
27	DB5(B5)
28	DB4(B4)
29	DB3(B3)
30	DB2(B2)
31	DB1(B1)
32	DB0(B0)
33	NC
34	NC
35	NC
36	NC
37	RESET
38	CS
39	NC
40	SCL
41	NC
42	PCLK
43	VSYNC
44	HSYNC
45	DE
46	SDO
47	SDI
48	NC
49	LEDA
50	LEDK

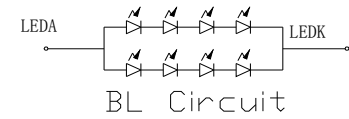
NOTE: RGB interface DB Used.

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 used RGB mode must select serial interface!

NOTES:

1. DISPLAY TYPE: 4.0", TFT-LCD, 65K/262K/16.7M COLORS
2. DISPLAY MODE: T/M NORMALLY BACK
3. VIEWING DIRECTION: ALL
4. DRIVER IC: ILI9806E (COG)
5. VCI: 3.3V(TYP)
6. OPERATING TEMP: -20°C TO 70°C  
STORAGE TEMP: -30°C TO 80°C
7. BACK LIGHT: LED WHITE, 8 LED, 40mA, 12.8±0.2V
8. RoHS COMPLIANT.



ReV	Revision content description	Date
A	FIRST	2016/01/22



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TOLBRANCE( )	DRAWING NAME	E40RB-FW600-N	
	PARTS NO.		
TOLERANCE UNLESS OTHERWISE SPECIFIED	Drawn		Unit
	Checked		mm
Scale 1:1	Approve		Page 1/1

### 3. Input Terminal Pin Assignment

NO.	Symbol	Description	I/O
1	YU(NC)	Touch panel top film terminal	A/D
2	XR(NC)	Touch panel right glass terminal	A/D
3	YD(NC)	Touch panel bottom film terminal	A/D
4	XL(NC)	Touch panel left glass terminal	A/D
5	GND	Ground	P
6	GND	Ground	P
7	VCI	Supply voltage (3.3V)	P
8	IOVCC	Power supply for I/O block (1.65-3.3V)	P
9-32	DB23-DB0	Data bus pins RGB data bus used 24-bit bus: DB23-DB0 18-bit bus: DB21-DB16, DB13-DB8, DB5-DB0 16-bit bus: DB20-DB16, DB13-DB8, DB4-DB0 If not used, pin to GND	I/O
33-36	NC	Not connected	
37	RESET	Reset pin. Setting either pin low initializes the LSI Must be reset after power is supplied	I
38	CS	Chip select signal Low: chip can be accessed High: chip cannot be accessed	I
39	NC	Not connected	
40	SCL	Serial clock input	I
41	NC	Not connected	
42	PCLK	Dot clock signal	
43	VSYNC	Frame synchronizing signal	I
44	HSYNC	Line synchronizing signal	I
45	DE	Data enable signal	I
46	SDO	Serial data output pin for the SPI interface Leave open when not used	O
47	SDI	Serial data input pin for the SPI interface	I
48	NC	Not connected	
49	LEDA	Anode pin of backlight	P
50	LEDK	Cathode pin of backlight	P

I: Input, O: Output, P: Power

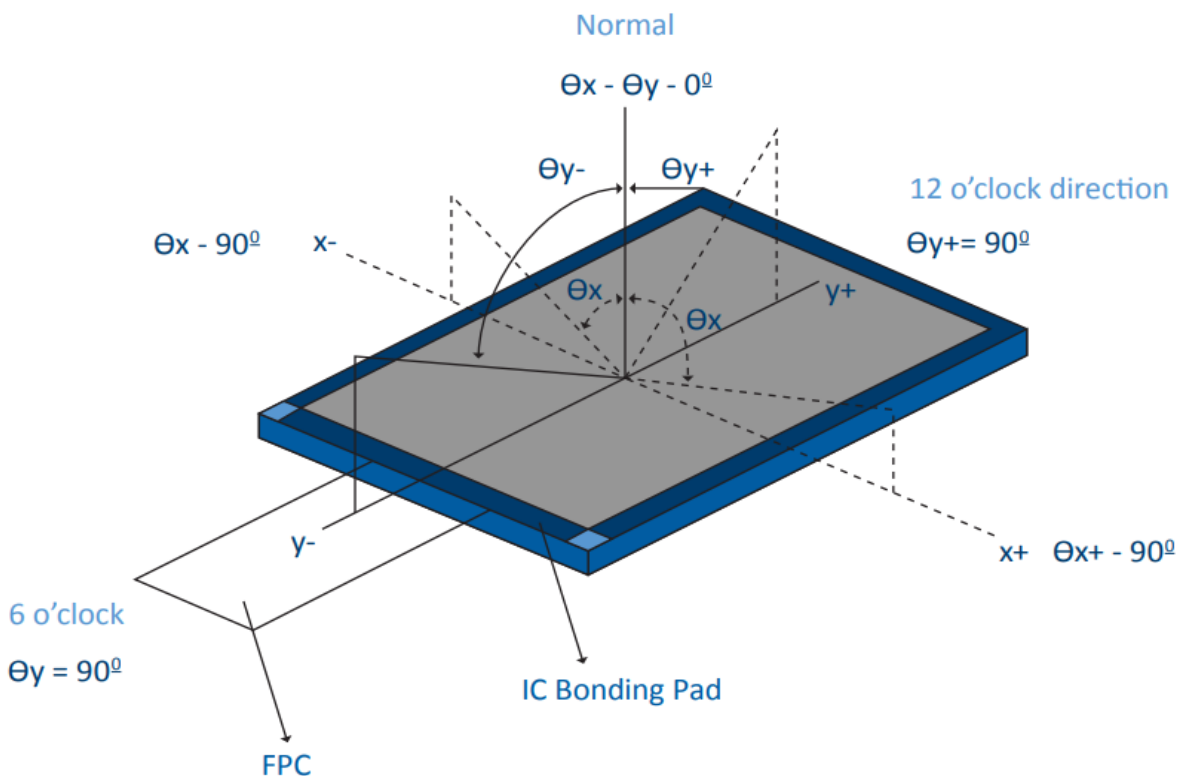
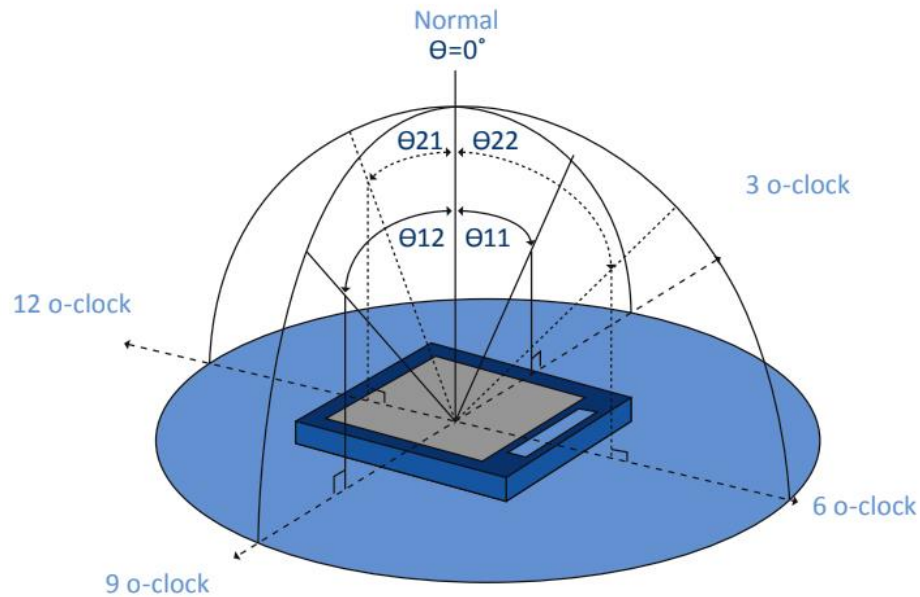
## 4. LCD Optical Characteristics

### 4.1 Optical Specifications

Item	Symbol	Condition	Min	Typ.	Max	Unit	Note	
Contrast Ratio	CR		550	800	--	--	(2)	
Response time	Rising	TR+TF	--	35	--	ms	(4)	
	Falling							
Color Filter Chromaticity	White	W <sub>X</sub>	0.277	0.292	0.307		(5)(6)	
		W <sub>Y</sub>	0.318	0.333	0.348			
	Red	R <sub>X</sub>	0.650	0.665	0.680			
		R <sub>Y</sub>	0.308	0.323	0.338			
	Green	G <sub>X</sub>	0.257	0.272	0.287			
		G <sub>Y</sub>	0.573	0.588	0.613			
	Blue	B <sub>X</sub>	0.119	0.134	0.149			
		B <sub>Y</sub>	0.106	0.121	0.136			
Viewing angle	Hor.	Θ <sub>L</sub>	CR≥10	80	85	--	degree	(1)(6)
		Θ <sub>R</sub>		80	85	--		
	Ver.	Θ <sub>T</sub>		80	85	--		
		Θ <sub>B</sub>		80	85	--		
Option View Direction	Free						(1)	

**Optical Specification Reference Notes:**

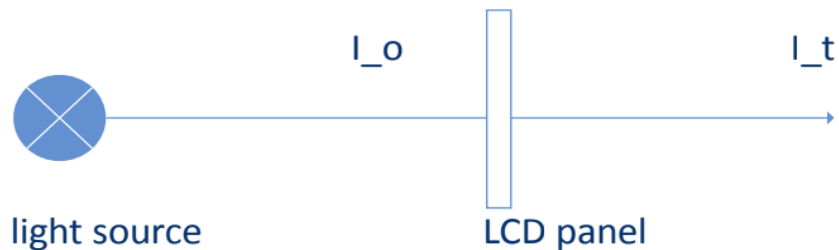
(1) Definition of Viewing Angle: The viewing angle is the angle at which the contrast ratio is greater than 10. The viewing angles are determined for the horizontal or 3,9 o'clock direction and the vertical or 6,12 o'clock direction with respect to the optical axis which is normal to the LCD surface.



(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.



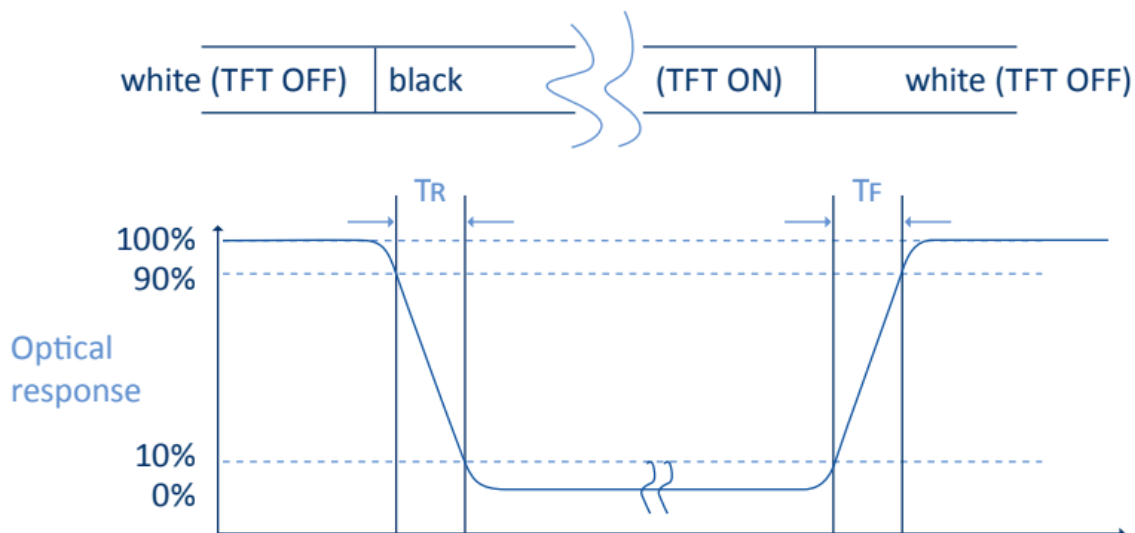
The transmittance is defined as:

$$Tr = \frac{I_t}{I_o} \times 100\%$$

I<sub>o</sub> = the brightness of the light source.

I<sub>t</sub> = 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.

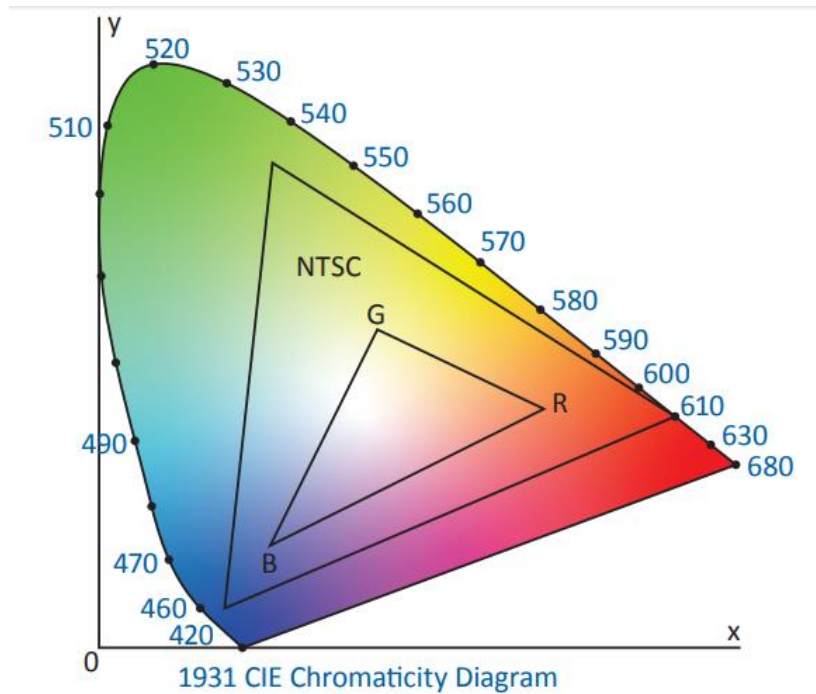
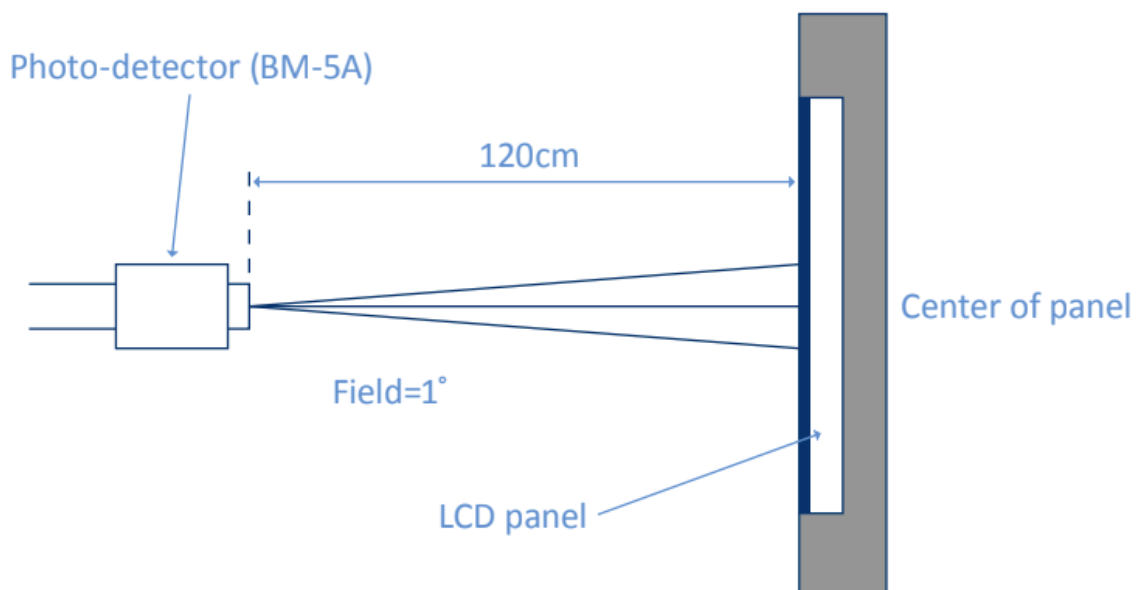


Fig. 1931 CIE chromacity diagram

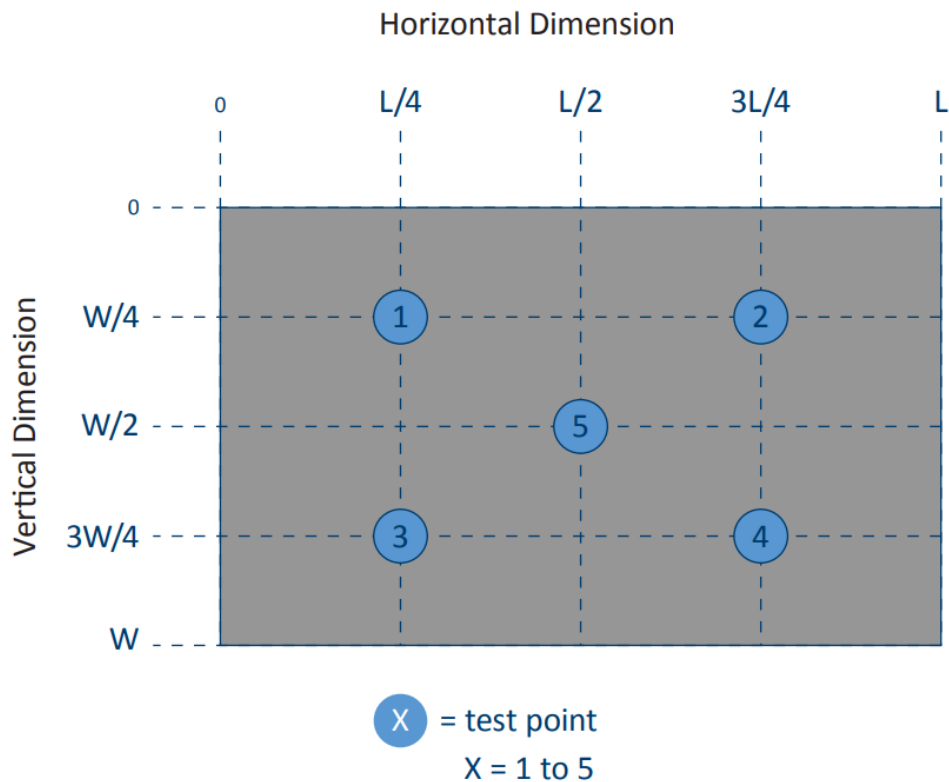
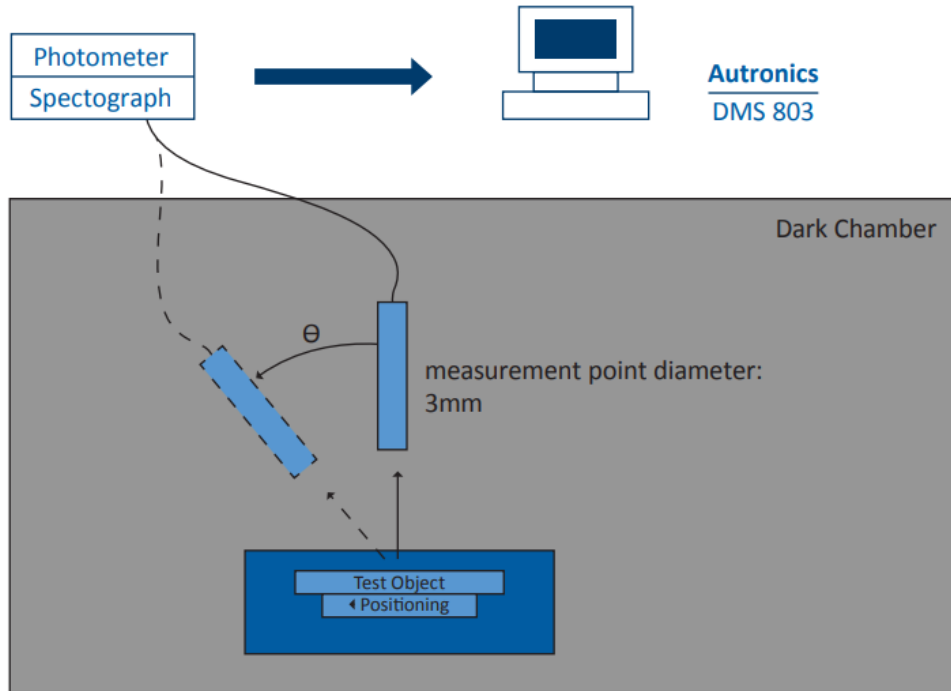
$$\text{Color gamut: } S = \frac{\text{Area of RGB triangle}}{\text{Area of NTSC triangle}} \times 100\%$$

(6) Definition of Optical Measurement Setup:



(6) Optical Measurement Setup Continued:

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. Electrical Characteristics

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

Characteristics	Symbol	Min	Max	Unit
Digital Supply Voltage	VCI	-0.3	4.6	V
Digital Interface Supply Voltage	IOVCC	-0.3	3.3	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	VCI	2.5	2.8/3.3	3.6	V	
Digital Interface Supply Voltage	IOVCC	1.65	1.8	3.3	V	
Normal Mode Current Consumption	IDD	--	30	--	mA	
Level Input Voltage	V <sub>IH</sub>	0.7IOVCC	--	IOVCC	V	
	V <sub>IL</sub>	GND	--	0.3IOVCC	V	
Level Output Voltage	V <sub>OH</sub>	0.8IOVCC	--	IOVCC	V	
	V <sub>OL</sub>	GND	--	0.2IOVCC	V	

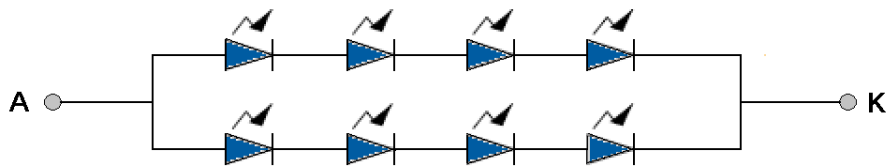
### 5.3 LED Backlight Characteristics

Item	Symbol	Min	Typ.	Max	Unit	Note
Forward Current	IF	30	40	--	mA	
Forward Voltage	VF	--	12.8	--	V	
LCM Luminance	LV	--	600	--	cd/m <sup>2</sup>	Note 3
LED lifetime	Hr	50000	--	--	hour	Note1 & 2
Uniformity	AVg	80	--	--	%	Note 3

The back-light system is edge-lighting type with 8 chips White LED

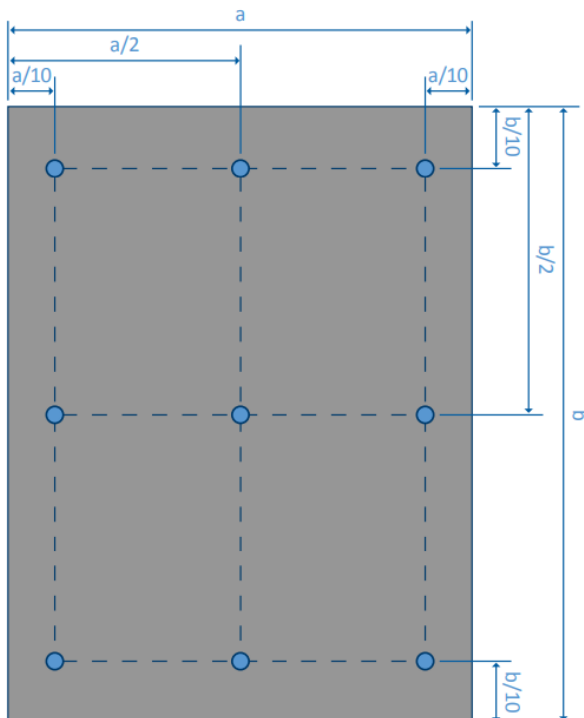
Note 1: LED lifetime (Hr) can be defined as the time in which it continues to operate under the condition: Ta=25±3 °C, typical IL value indicated in the above table until the brightness becomes less than 50%.

Note 2: The “LED lifetime” is defined as the module brightness decrease to 50% original brightness at Ta=25°C and IL=40mA. The LED lifetime could be decreased if operating IL is larger than 40mA. The constant current driving method is suggested.



Backlight LED Circuit

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 Timing Characteristics

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

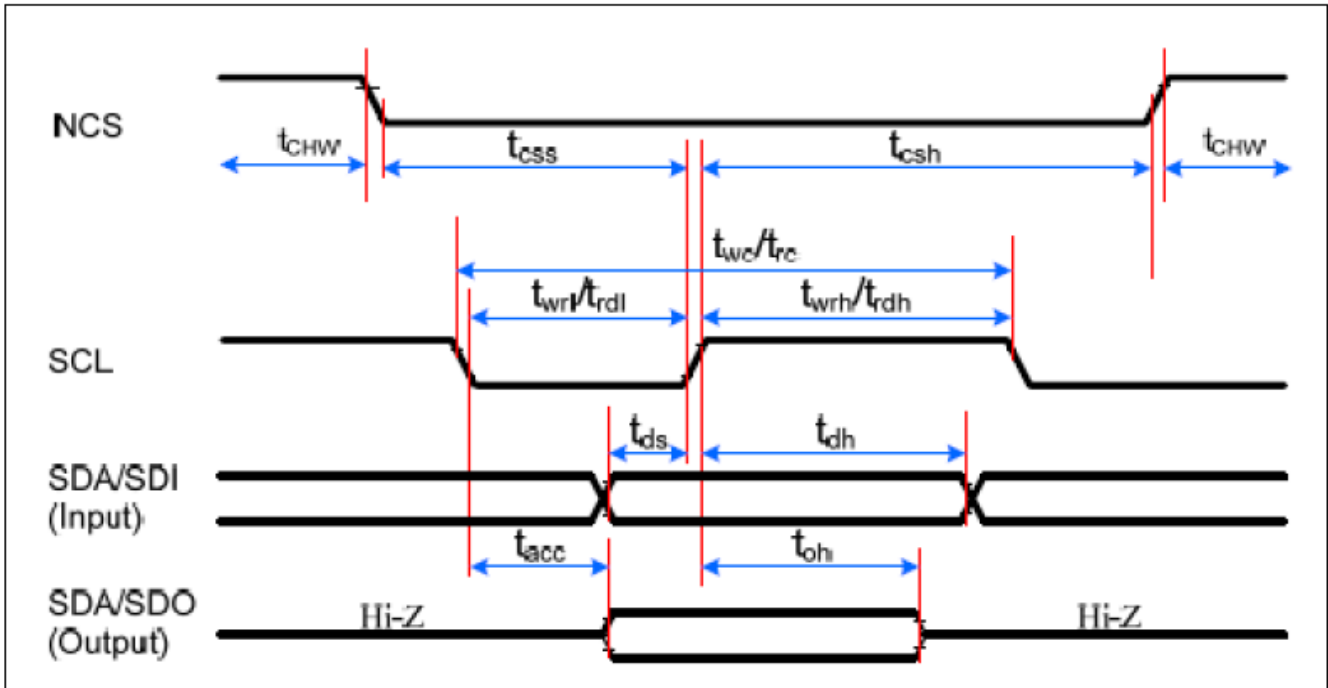


Figure 6.1: 3-wire Serial Interface Timing Diagram

Signal	Symbol	Parameter	Min	Max	Unit	Note
CSX	t <sub>css</sub>	Chip select time (Write)	15	-	ns	
	t <sub>csh</sub>	Chip select hold time (Read)	15	-	ns	
	t <sub>chW</sub>	CS "H" pulse width	40	-	ns	
SCL	t <sub>wc</sub>	Serial clock cycle (Write)	30	-	ns	
	t <sub>wrh</sub>	SCL "H" pulse width (Write)	10	-	ns	
	t <sub>wrl</sub>	SCL "L" pulse width (Write)	10	-	ns	
	t <sub>rc</sub>	Serial clock cycle (Read)	150	-	ns	
	t <sub>rdh</sub>	SCL "H" pulse width (Read)	60	-	ns	
	t <sub>rdl</sub>	SCL "L" pulse width (Read)	60	-	ns	
SDA/SDO (Output)	t <sub>acc</sub>	Access time (Read)	10	100	ns	Max CL=30pF Min CL=8pF
	t <sub>oh</sub>	Output disable time (Read)	15	100	ns	
SDA/SDI (Input)	t <sub>ds</sub>	Data setup time (Write)	10	-	ns	
	t <sub>dh</sub>	Data hold time (Write)	10	-	ns	

Table 6.1: 3-wire Serial Interface Timing Characteristics

Note:  $T_a = -30$  to  $70^\circ\text{C}$ ,  $IOVCC = 1.65$  to  $3.6\text{V}$ ,  $V_{CI} = 2.5$  to  $3.6\text{V}$ ,  $T = 10 \pm 0.5\text{ns}$   
 Does not include signal rise and fall times

## 6.2 Parallel RGB Interface Timing Characteristics

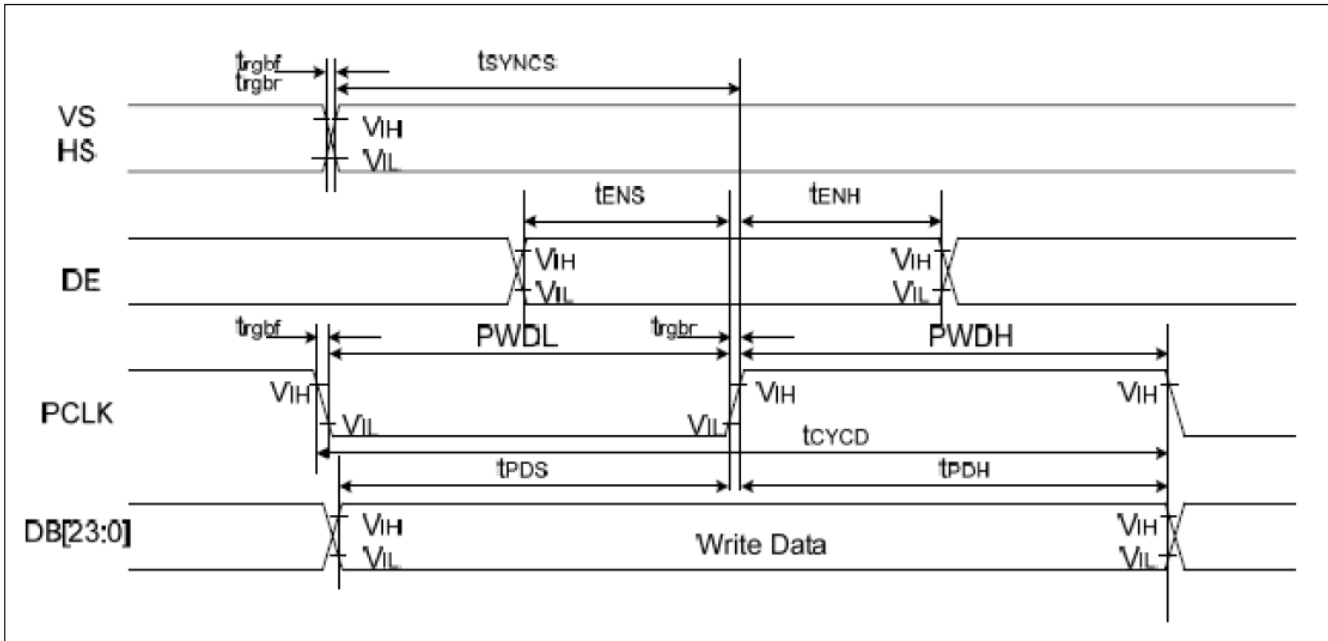


Figure 6.2: Parallel RGB Interface Timing Diagram

Signal	Symbol	Parameter	Min	Max	Unit	Note
VS/HS	tSYNCS	VS/HS setup time	5	-	ns	24/18/16-bit bus RGB interface mode
	tSYNCH	VS/HS hold time	5	-	ns	
DE	tENS	DE setup time	5	-	ns	
	tENH	DE hold time	5	-	ns	
DB[23:0]	tPOS	Data setup time	5	-	ns	
	tpDH	Data hold time	5	-	ns	
PCLK	PWDH	PCLK high-level period	13	-	ns	
	PWDL	PCLK low-level period	13	-	ns	
	tCYCD	PCLK cycle time	28	-	ns	
	trgbr, trgbf	CLK, HS, VS rise/fall time	-	15	ns	

Table 6.2: Parallel RGB Interface Timing Characteristics

Note:  $T_a = -30$  to  $70^\circ\text{C}$ ,  $IOVCC = 1.65$  to  $3.6\text{V}$ ,  $V_{CI} = 2.5$  to  $3.6\text{V}$ ,  $DGND = 0\text{V}$

### 6.3 DPI Interface Timing

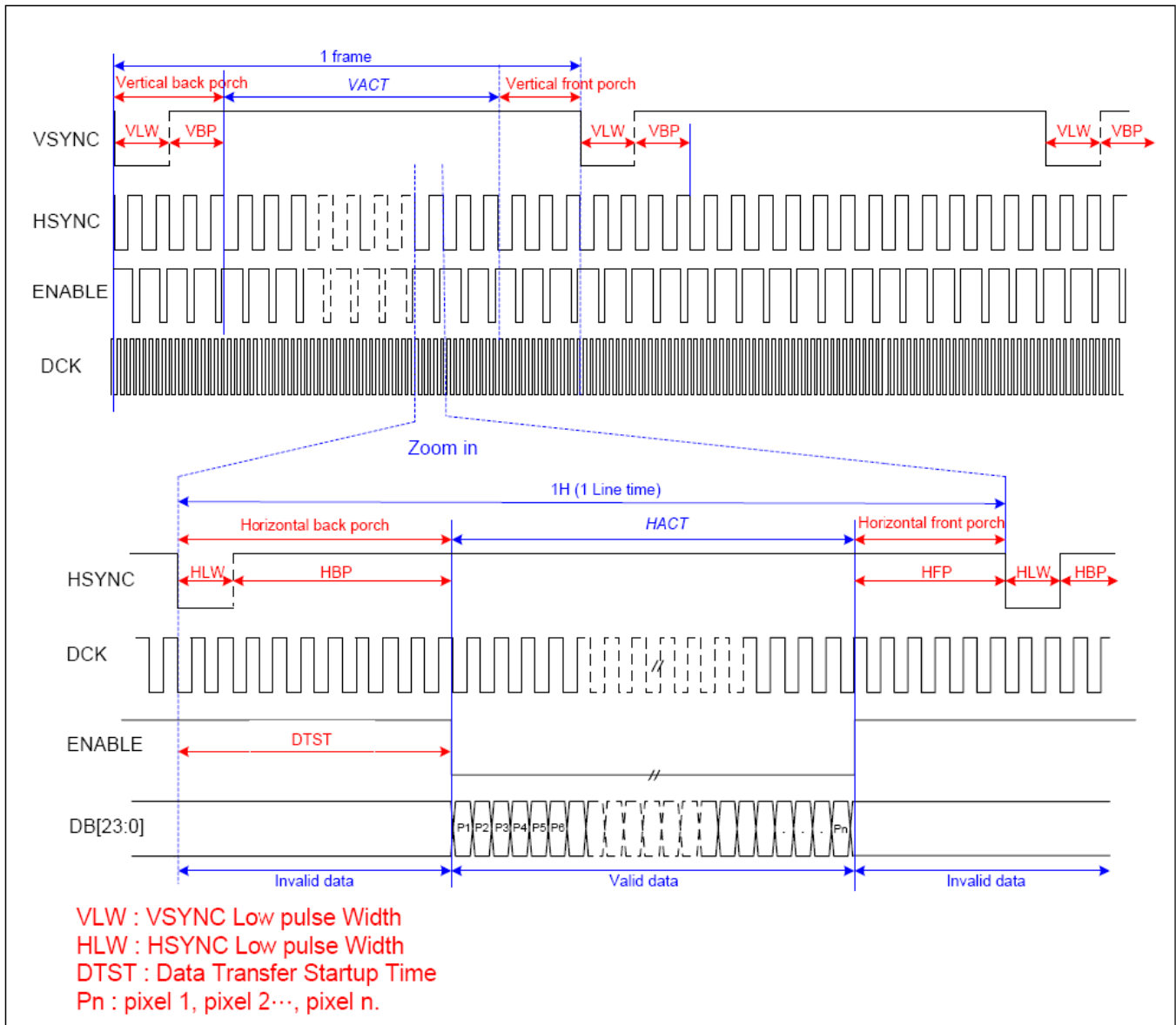


Figure 6.3: DPI Interface Timing Diagram

Parameter	Symbol	Min	Typ.	Max	Unit	Note
Frame Rate	FR	54	-	66	fps	
Horizontal Low Pulse Width	HLW	1	-	-	DOTCLK	
Horizontal Back Porch	HBP	2	-	126	DOTCLK	
Horizontal Address	HACT	-	480	-	DOTCLK	
Horizontal Front Porch	HFP	2	-	-	DOTCLK	
Vertical Low Pulse Width	VLW	1	-	126	Line	
Vertical Back Porch	VBP	1	-	126	Line	
Vertical Address	VACT	-	-	864	Line	
Vertical Front Porch	VFP	1	-	255	Line	
Data Clock	DCLK	16.6	-	41.7	MHz	

Table 6.3: DPI Interface Timing Characteristics

## 6.4 Reset Timing

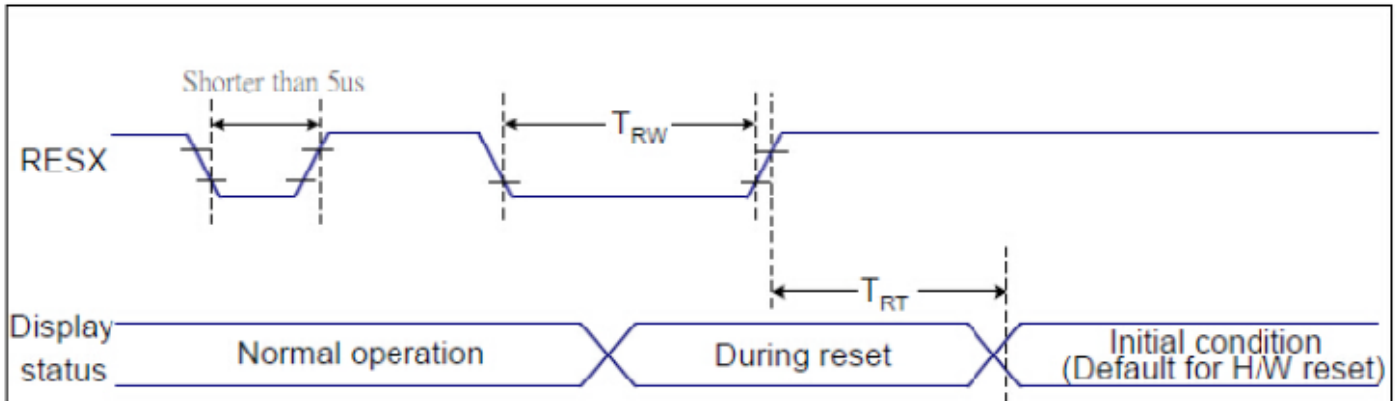


Figure 6.4: Reset Timing Diagram

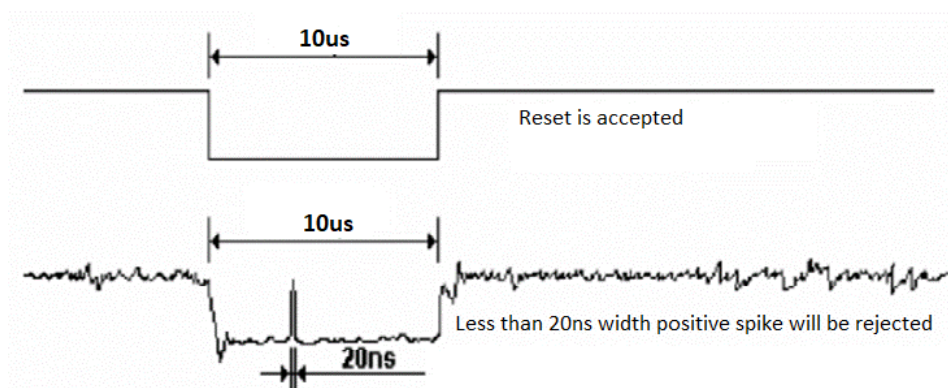
Related Pins	Symbol	Parameter	Min	Max	Unit
RESX	TRW	Reset pulse duration	10	-	us
	TRT	Reset cancel	-	5 (Note 1,5)	ms
				120 (Note 1, 6, 7)	ms

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.