HIGH BRIGHTNESS 2.0" DISPLAY

P/N: DJA-7358-S000

* Description

This is a color active matrix TFT (Thin Film Transistor) LCD (liquid crystal display) that uses amorp hous silicon TFT as a switching device. This module is composed of a Transmissive type TFT-LCD panel, driver circuit,back-light unit. The resolution of a 2.0 " TFT-LCD contains 480x360 pixels, and can display up to 16.7M colors.

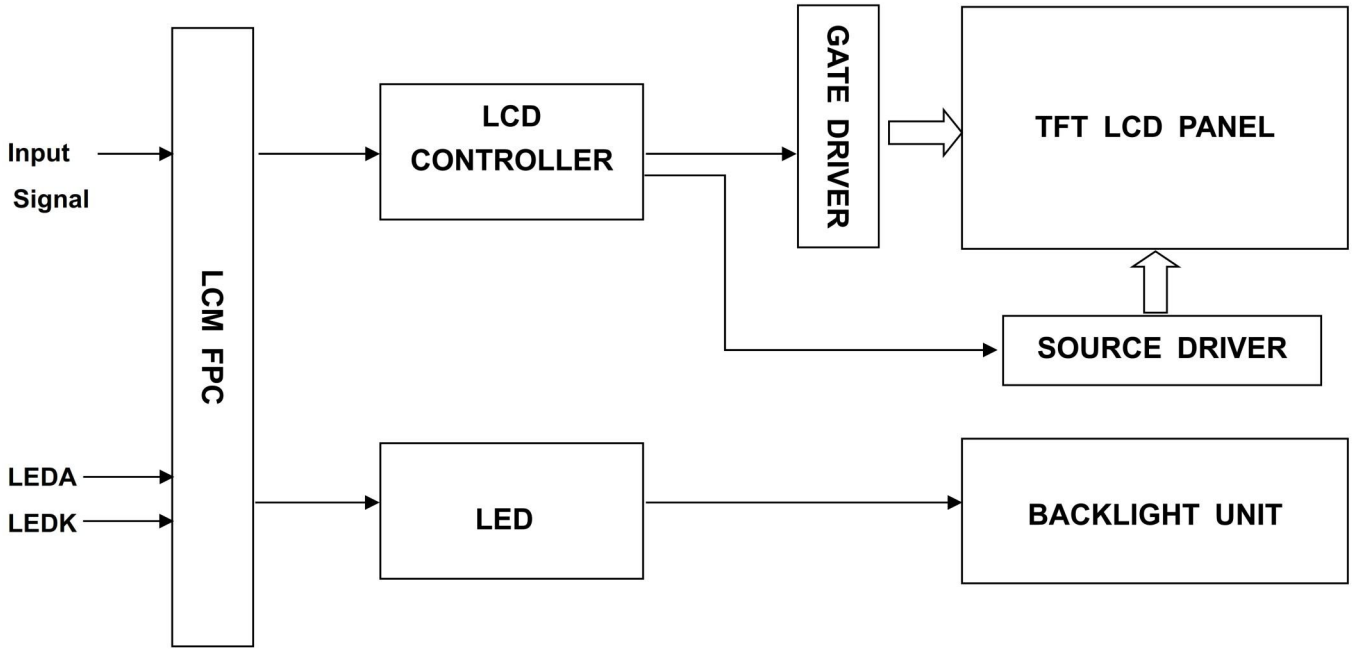
* Features

General Information Items	Specification	Unit	Note
	Main Panel		
Display area(AA)	40.824(H)*30.618(V) (2.0 inch)	mm	
Driver element	TFT active matrix	-	
Display colors	16.7M	colors	
Number of pixels	480(RGB)*360	dots	
Pixel arrangement	RGB tilt stripe	-	
Pixel pitch	0.08505(H)*0.08505(V)	mm	
Viewing angle	Free	o'clock	
Controller IC	ST7701S	-	
LCM Interface	3SPI+16/18/24BIT RGB	-	
Display mode	Transmissive /Normally Black	-	
Operating temperature	-30～+85	℃	
Storage temperature	-30～+85	℃	

* Mechanical Information

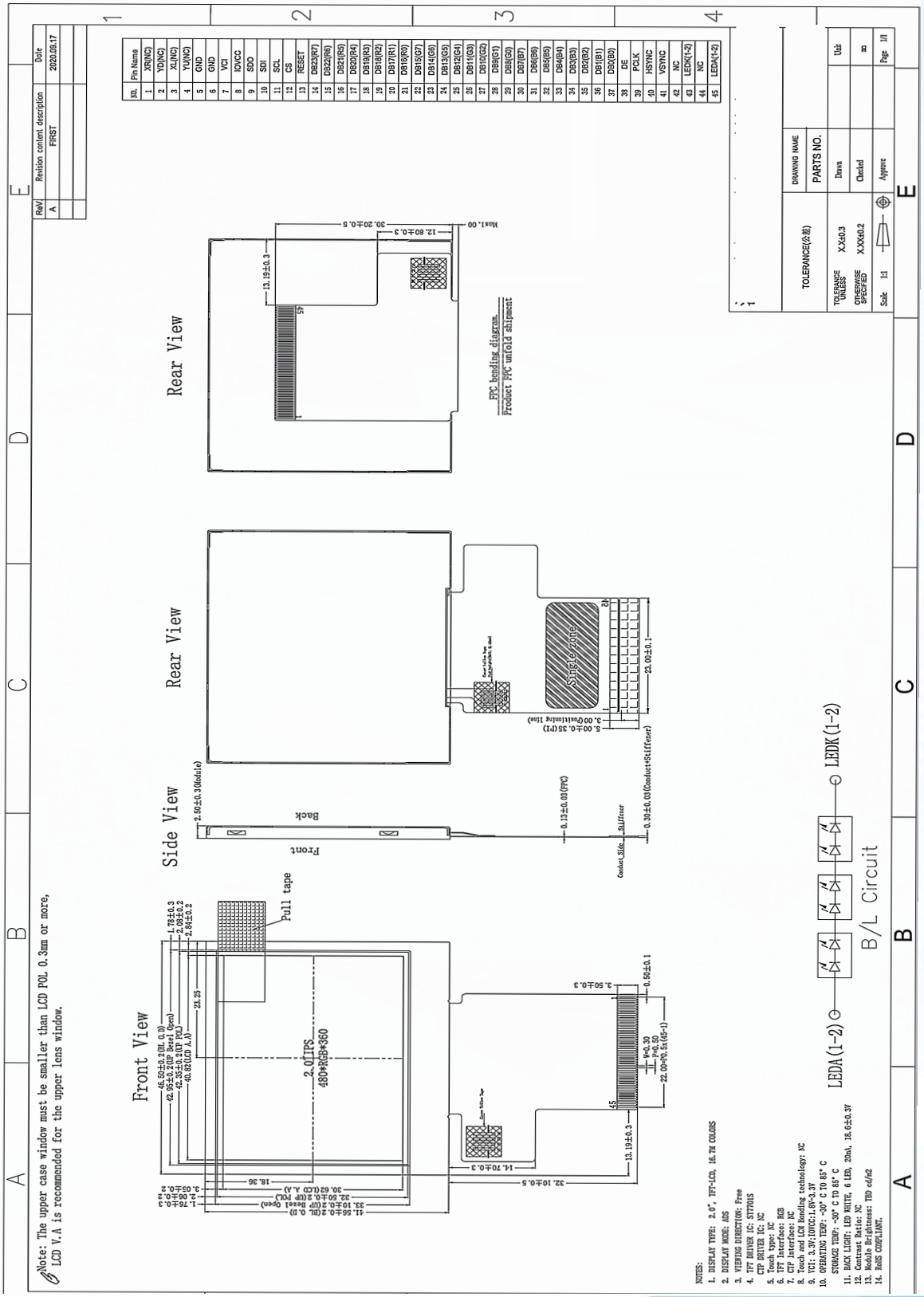
Item		Min.	Typ.	Max.	Unit	Note
Module size	Horizontal(H)	-	46.5	-	mm	
	Vertical(V)	-	41.56	-	mm	
	Depth(D)	-	2.5	-	mm	
Weight		-	10	-	g	

1. Block Diagram



RoHS COMPLIANT

2. Outline dimension



3. Input terminal Pin Assignment

NO.	SYMBOL	DISCRIPTION	I/O
1	XR(NC)	Touch panel Right Glass Terminal. Leave the pin open when not in use.	A/D
2	YD(NC)	Touch panel Bottom Film Terminal. Leave the pin open when not in use.	A/D
3	XL(NC)	Touch panel LEFT Glass Terminal. Leave the pin open when not in use.	A/D
4	YU(NC)	Touch panel Top Film Terminal. Leave the pin open when not in use.	A/D
5	GND	Ground.	P
6	GND	Ground.	P
7	VCI	Supply voltage (3.3V).	P
8	IOVCC	Supply Voltage (Logic)(1.8~3.3V).	P
9	SDO	Serial data output pin used for the SPI Interface. Leave the pin open when not in use.	O
10	SDI	SDI: Serial data input/output bidirectional pin for SPI Interface.	I/O
11	SCL	SCL: Serial clock input for SPI interface.	I
12	CS	- A chip select signal Low: the chip is selected and accessible High: the chip is not selected and not accessible	I
13	RESET	- The external reset input - Initializes the chip with a low input. Be sure to execute a power-on reset after supplying power.	I
14-37	DB23-DB0	24-bit parallel data bus for RGB Interface. Fix to IOVCC or GND level when not in use.	I/O
38	DE	Data enable signal for RGB interface operation Low: access enabled High: access inhibited Fix to IOVCC or GND level when not in use.	I
39	PCLK	Dot clock signal for RGB interface operation	I
40	HSYNC	Line synchronizing signal for RGB interface operation	I
41	VSYNC	Frame synchronizing signal for RGB interface operation	I

42	NC		--
43	LEDK(1-2)	Cathode pin of backlight.	P
44	NC		--
45	LEDA(1-2)	Anode pin of backlight.	P

4. LCD Optical Characteristics

4.1 Optical specification

Item		Symbol	Condition	Min.	Typ.	Max.	Unit.	Note
Contrast Ratio		CR	Θ=0 Normal viewing angle	800	1000	--		(1)(2)
Response time	Rising	$T_{R+}T_F$		--	35	45	msec	(1)(3)
	Falling							
Color Gamut		S(%)		50	55	--	%	*
Color Filter Chromacicity	White	W_X		0.2691	0.3091	0.3491		(1)(4) CA-310
		W_Y		0.2980	0.3380	0.3780		
	Red	R_X		0.5654	0.6054	0.6454		
		R_Y		0.3283	0.3683	0.4083		
	Green	G_X		0.2905	0.3305	0.3805		
		G_Y		0.5355	0.5755	0.6155		
	Blue	B_X		0.1046	0.1446	0.1846		
		B_Y		0.0437	0.0837	0.1237		
Viewing angle	Hor.	ΘL	CR>10	75	80	--		(1)(4)
		ΘR		75	80	--		
	Ver.	ΘU		75	80	--		
		ΘD		75	80	--		
Option View Direction		Free						

*The data comes from the LCD specification.

Measuring Condition

Measuring surrounding : dark room

Ambient temperature : 25±2°C

15min. warm-up time.

Measuring Equipment

FPM520 of Westar Display technologies, INC., which utilized SR-3 for Chromaticity and BM-5A for other optical characteristics.

5. Electrical Characteristics

5.1 Absolute Maximum Rating

Characteristics	Symbol	Min.	Max.	Unit	Note
Digital Supply Voltage	VCI	-0.3	4.6	V	Note1
Digital Interface Supply Voltage	IOVCC	-0.3	4.6	V	
Operating temperature	T_{OP}	-30	+85	℃	
Storage temperature	T_{ST}	-30	+85	℃	

NOTE1: If the absolute maximum rating of even is one of the above parameters is exceeded even momentarily, the quality of the product may be degraded. Absolute maximum ratings, therefore, specify the values exceeding which the product may be physically damaged. 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	3.3	3.6	V	
Digital interface supple Voltage	IOVCC	1.65	1.8	3.3	V	
Normal mode Current	IDD	--	25	50	mA	
Level input voltage	V_{IH}	0.7* IOVCC	--	IOVCC	V	
	V_{IL}	GND	--	0.3* IOVCC	V	
Level output voltage	V_{OH}	0.8*IOVCC	--	IOVCC	V	
	V_{OL}	GND	--	0.2*IOVCC	V	

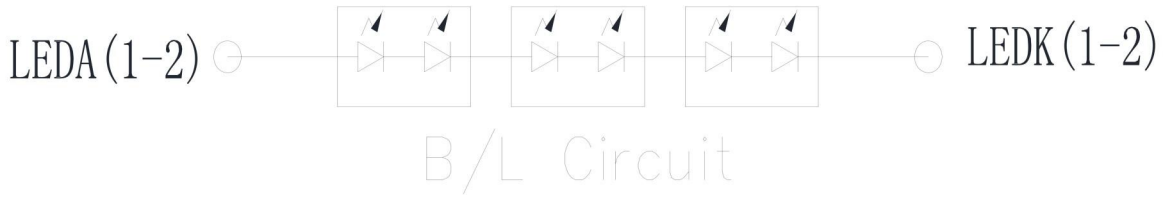
5.3 LED Backlight Characteristics

The back-light system is edge-lighting type with 6 chips LED

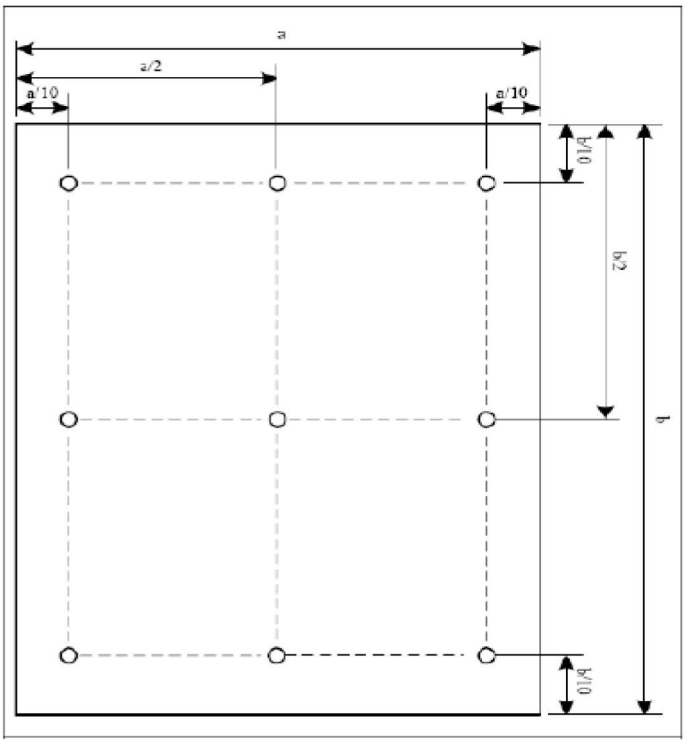
Item	Symbol	Min.	Typ.	Max.	Unit	Note
Forward Current	I_F	15	20	--	mA	
Forward Voltage	V_F	--	18.6	--	V	
LCM Luminance	LV	850	900	--	cd/m2	Note3
LED life time	Hr	30000	--	--	Hour	Note1,2
Uniformity	Avg	80	--	--	%	Note3

Note1: LED life time (Hr) can be defined as the time in which it continues to operate under the condition: Ta=25±3 ℃, typical IL value indicated in the above table until the brightness becomes less than 50%.

Note 2: The “LED life time” is defined as the module brightness decrease to 50% original brightness at Ta=25℃ and IL=20mA. The LED lifetime could be decreased if operating IL is larger than 20mA. The constant current driving method is suggested.



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

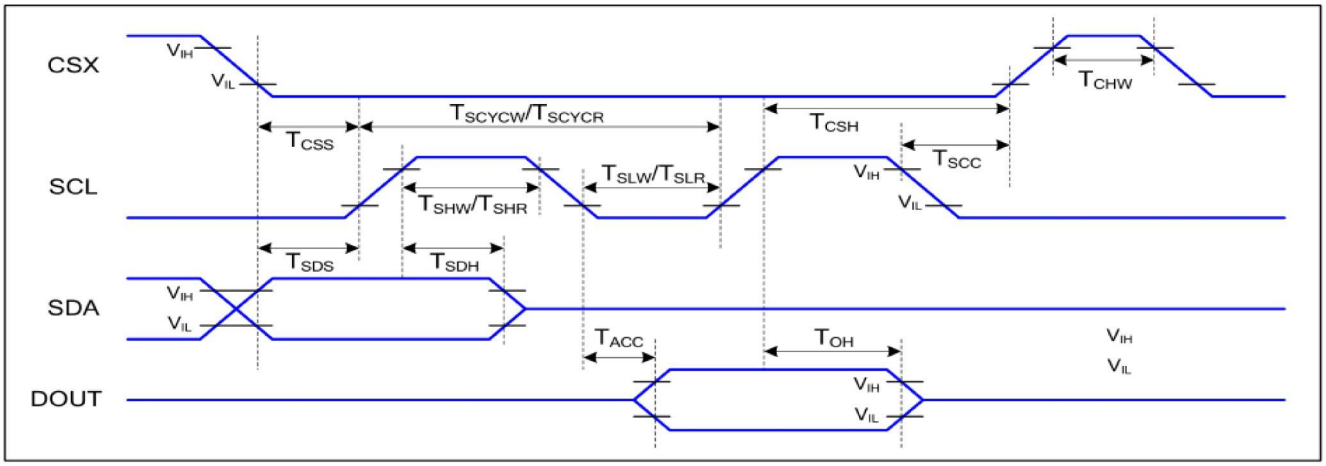


$$\text{Uniformity} = \frac{\text{minimum luminance in 9 points (1-9)}}{\text{maximum luminance in 9 points (1-9)}}$$

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

6. AC Characteristics

6.1 Serial Interface Characteristics (3-line serial):

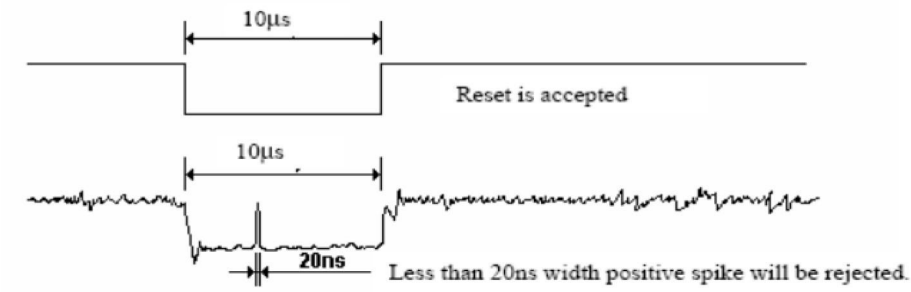


3-line serial Interface Timing Characteristics

IOVCC=1.8V,VCI=2.8V,Ta=25℃

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” pulse 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	

Note : The rising time and falling time (Tr, Tf) of input signal are specified at 15 ns or less. Logic high and low levels are specified as 30% and 70% of IOVCC for Input signals.



5. When Reset applied during Sleep In Mode.

6. When Reset applied during Sleep Out Mode.

7. It is necessary to wait 5msec after releasing RESX before sending commands. Also Sleep Out command cannot be sent for 120msec.

7. RGB Interface

The ST7701 support RGB interface Mode 1 and Mode 2. The interface signals as shown in ST7701S datasheet table 6.3.1.The Mode 1 and Mode 2 function is select by setting in the Command 2, please reference application note.In RGB Mode 1, writing data to line buffer is done by PCLK and Video Data Bus (D[23:0]), when DE is high state.The external clocks (PCLK, VS and HS) are used for internal displaying clock. So, controller must always transfer
PCLK, VS and HS signal to ST7701.In RGB Mode 2, back porch of Vsync is defined by VBP[5:0] of RGBPRCTR command. And back porch of Hsync is defined by HBP[5:0] of RGBPRCTR command. Front porch of Vsync is defined by VFP[5:0] of RGBPRCTR

command. And front porch of Hsync is defined by HFP[5:0] of RGBPRCTR command.

RGB I/F Mode	PCLK	DE	VS	HS	DB[23:0]	Register for Blanking Porch setting
RGB Mode 1	Used	Used	Used	Used	Used	Not Used
RGB Mode 2	Used	Not Used	Used	Used	Used	Used

Symbol	Name	Description
PCLK	Pixel clock	Pixel clock for capturing pixels at display interface
HS	Horizontal sync	Horizontal synchronization timing signal
VS	Vertical sync	Vertical synchronization timing signal
DE	Data enable	Data enable signal (assertion indicates valid pixels)
DB[23:0]	Pixel data	Pixel data in 16-bit,18-bit and 24-bit format

The interface signals of RGB interface

7.1.1 RGB Color Format

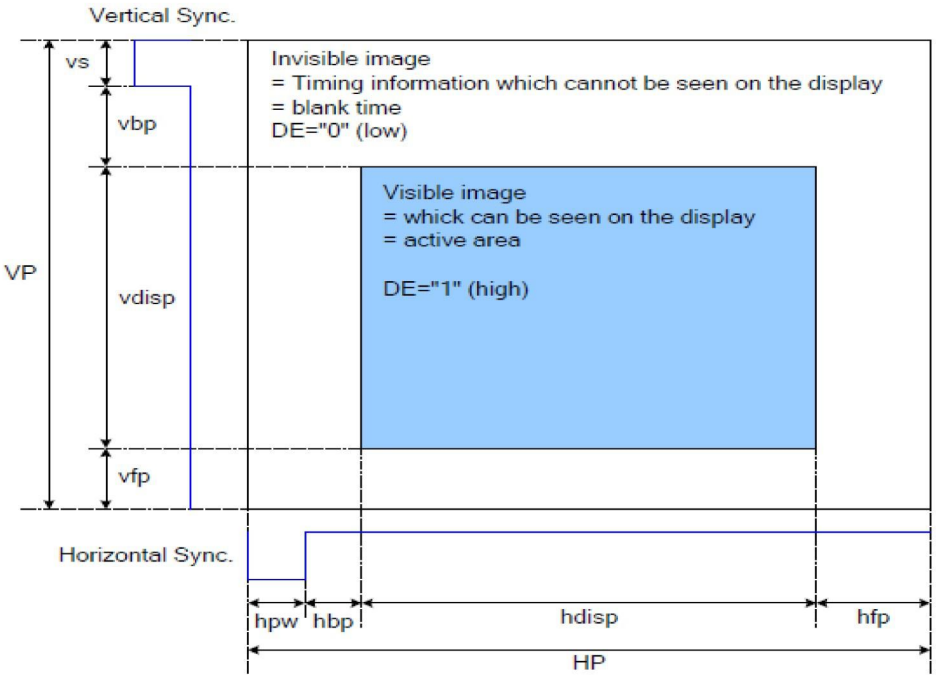
ST7701 supports two kinds of RGB interface, DE mode (mode 1) and HV mode (mode 2), and 16bit/18bit and 24 bit data format. When DE mode is selected and the VSYNC, HSYNC, DOTCLK, DE, D[17:0] pins can be used;when HV mode is selected and the VSYNC, HSYNC, DOTCLK, D[17:0] pins can be used. When using RGB interface, only serial interface can be selected.

Pad name	24 bits configuration VIPF[3:0]=0111	18 bits configuration VIPF[3:0]=0110		16 bits configuration VIPF[3:0]=0101
		MDT=0	MDT=1	
DB[23]	R7	Not used	Not used	Not used
DB[22]	R6	Not used	Not used	Not used
DB[21]	R5	R5	Not used	Not used
DB[20]	R4	R4	Not used	R4
DB[19]	R3	R3	Not used	R3
DB[18]	R2	R2	Not used	R2
DB[17]	R1	R1	R5	R1
DB[16]	R0	R0	R4	R0
DB[15]	G7	Not used	R3	Not used
DB[14]	G6	Not used	R2	Not used
DB[13]	G5	G5	R1	G5
DB[12]	G4	G4	R0	G4
DB[11]	G3	G3	G5	G3
DB[10]	G2	G2	G4	G2
DB[09]	G1	G1	G3	G1
DB[08]	G0	G0	G2	G0
DB[07]	B7	Not used	G1	Not used
DB[06]	B6	Not used	G0	Not used
DB[05]	B5	B5	B5	Not used
DB[04]	B4	B4	B4	B4
DB[03]	B3	B3	B3	B3
DB[02]	B2	B2	B2	B2
DB[01]	B1	B1	B1	B1
DB[00]	B0	B0	B0	B0

The interface color mapping of RGB interface

7.1.2 RGB Interface Definition

The display operation via the RGB interface is synchronized with the VSYNC, HSYNC, and DOTCLK signals. The data can be written only within the specified area with low power consumption by using window address function. The back porch and front porch are used to set the RGB interface timing.



DRAM Access Area by RGB Interface

Please refer to the following table for the setting limitation of RGB interface signals.

Parameter	Symbol	Min.	Typ.	Max.	Unit
DCLK frequency	FCLK	--	12	--	MHz
Horizontal Sync. Width	hpw	1	2	255	Clock
Horizontal Sync. Back Porch	hbp	1	20	255	Clock
Horizontal Sync. Front Porch	hfp	1	8	--	Clock
Vertical Sync. Width	vs	1	2	254	Line
Vertical Sync. Back Porch	vbp	1	20	254	Line
Vertical Sync. Front Porch	vfp	1	10	--	Line

Note:

1. Typical value are related to the setting frame rate is 60Hz..

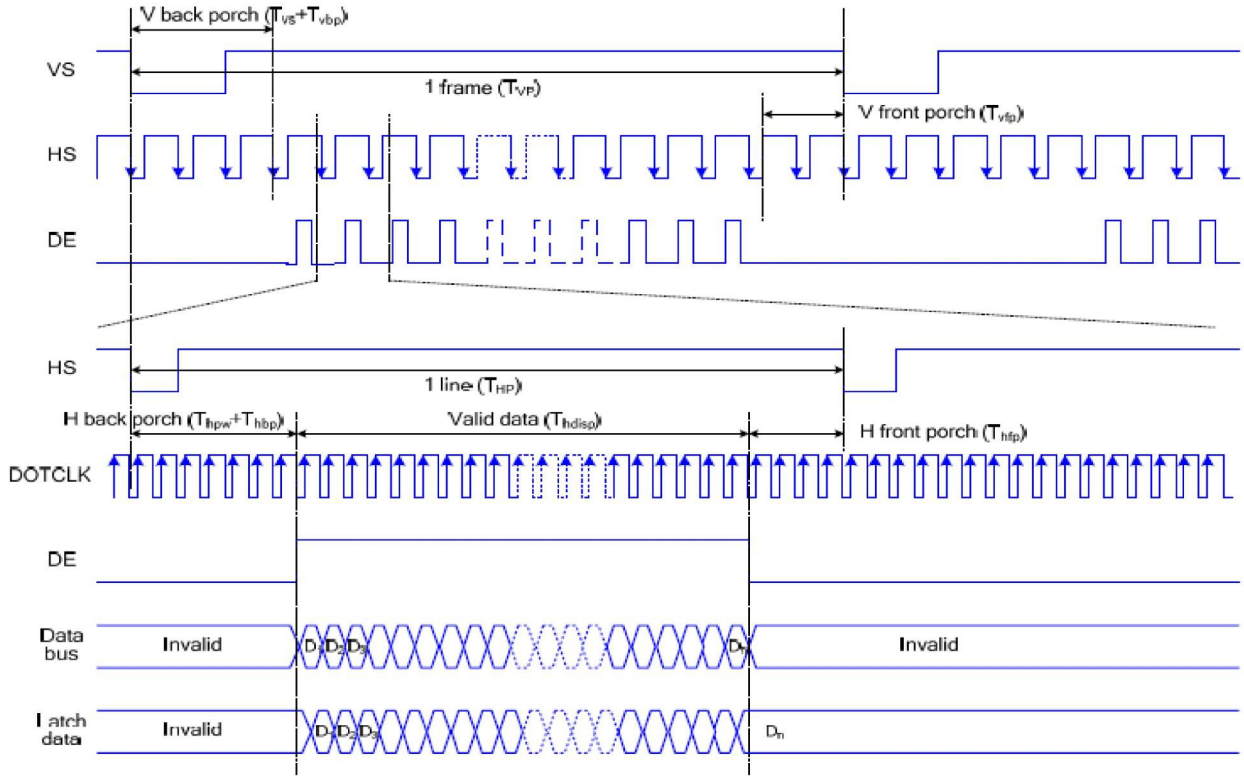
7.1.3 RGB Interface Mode Selection

ST7701 supports two kinds of RGB interface, DE mode and HV mode. The table shown below uses command C3h to select RGB interface mode.

DE/Sync	RGB Mode
0	DE mode
1	HV mode

7.1.4 RGB Interface Timing

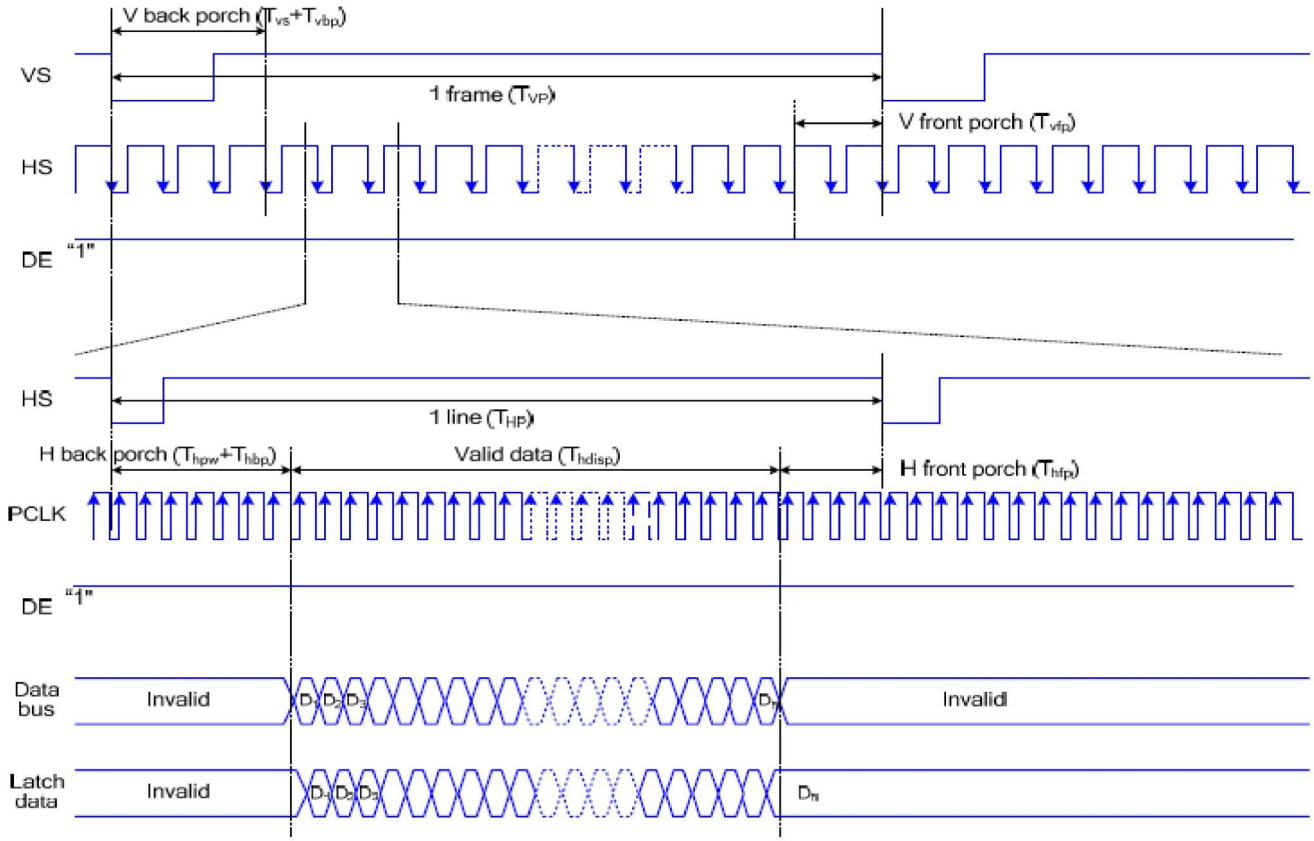
The timing chart of RGB interface DE mode is shown as follows.



Note: The setting of front porch and back porch in host must match that in IC as this mode.

Timing Chart of Signals in RGB Interface DE Mode

The timing chart of RGB interface HV mode is shown as follows.



Timing chart of RGB interface HV mod