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SPECIFICATION FOR LCM+CTP Module

MODULE No:	ET020WQ20-KT V1
CUSTOMER:	

YOURITECH	INITIAL	DATE
PREPARED BY		
CHECKED BY		
APPROVED BY		

CUSTOMER	INITIAL	DATE
APPROVED BY		



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1.Basic Specifications

* 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 module is composed of a Transmissive type TFT-LCD Panel, driver circuit, capacitance touch panel, back-light unit. The resolution of a 2.0 " TFT-LCD contains 480x360 pixels, and can display up to 16.7M colors.

1.1 TFT 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	℃	
Module bonding technology	Tape bonding between LCM and CTP	-	

1.2 CTP Features

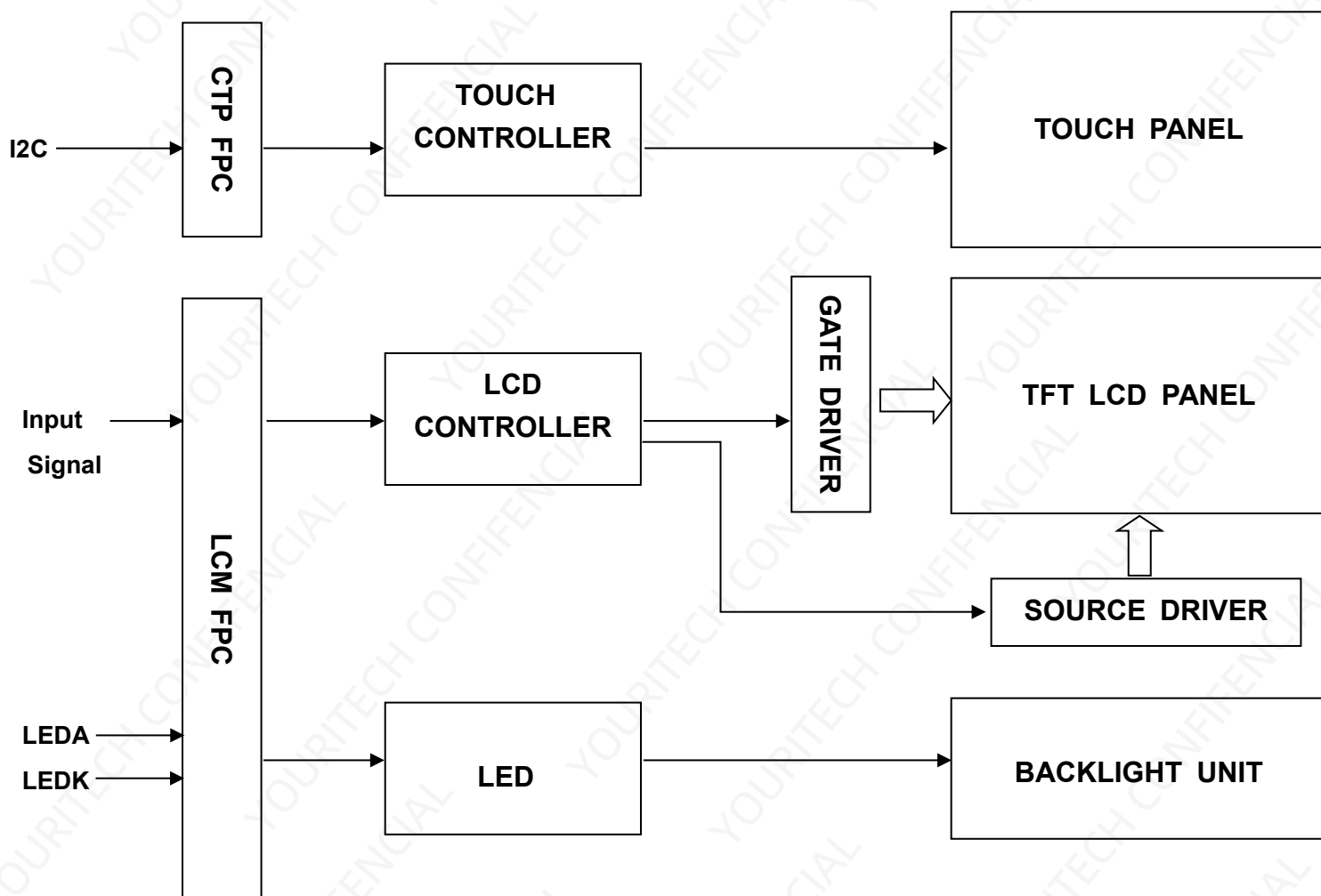
General Information Items	Specification	Unit	Note
	Main Panel		
Resolution	480(H)*360(V)	-	
Structure	G+G	-	
Controller IC	FT5436	-	
Interface	I2C	-	
Slave Address	0x38(7bit)/8bit:0x70(Write) 0x71(Read)	-	
Touch mode	Multipoint and gesture	-	-
Logic level	3.3	V	



1.3 Mechanical Information

Item		Min.	Typ.	Max.	Unit	Note
Module size	Horizontal(H)	-	54.5	-	mm	
	Vertical(V)	-	47.56	-	mm	
	Depth(D)	-	4.15	-	mm	
Weight		-	TBD	-	g	

2. Block Diagram



4. Input terminal Pin Assignment

4.1 TFT PIN Define

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

4.2 CTP PIN Define

NO.	SYMBOL	DISCRIPTION	I/O
1	GND	Ground.	P
2	VDDIO	I/O power supply voltage.	P
3	VDD	Supply voltage.	P
4	SCL	I2C clock input.	I
5	SDA	I2C data input and output	I/O
6	INT	External interrupt to the host.	I
7	RST	External Reset, Low is active.	I
8	GND	Ground.	P



5. LCD Optical Characteristics

5.1 Optical specification

Item		Symbol	Condition	Min.	Typ.	Max.	Unit.	Note
Contrast Ratio		CR	$\Theta=0$ 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 Chromaticity	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.	Θ_L	CR>10	75	80	--		(1)(4)
		Θ_R		75	80	--		
	Ver.	Θ_U		75	80	--		
		Θ_D		75	80	--		
Option View Direction		Free						

*The data comes from the LCD specification.

Measuring Condition

Measuring surrounding : dark room

Ambient temperature : $25 \pm 2^\circ\text{C}$

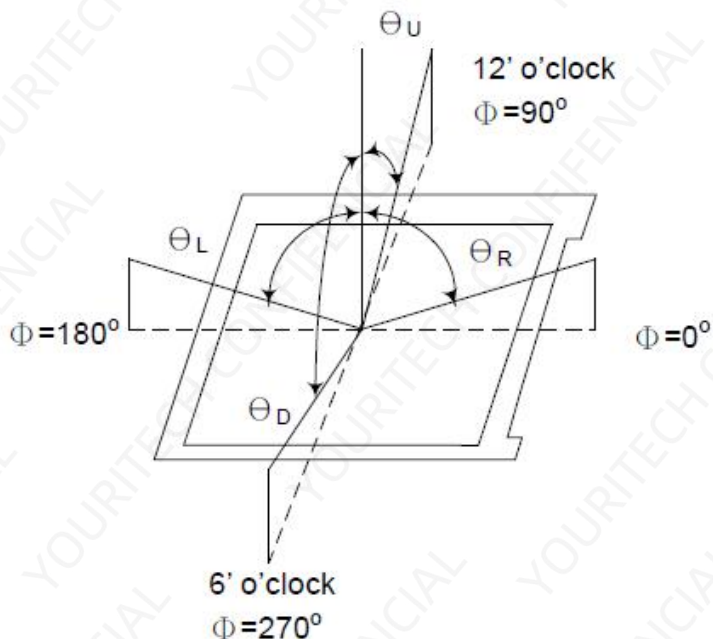
15min. warm-up time.

Measuring Equipment

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



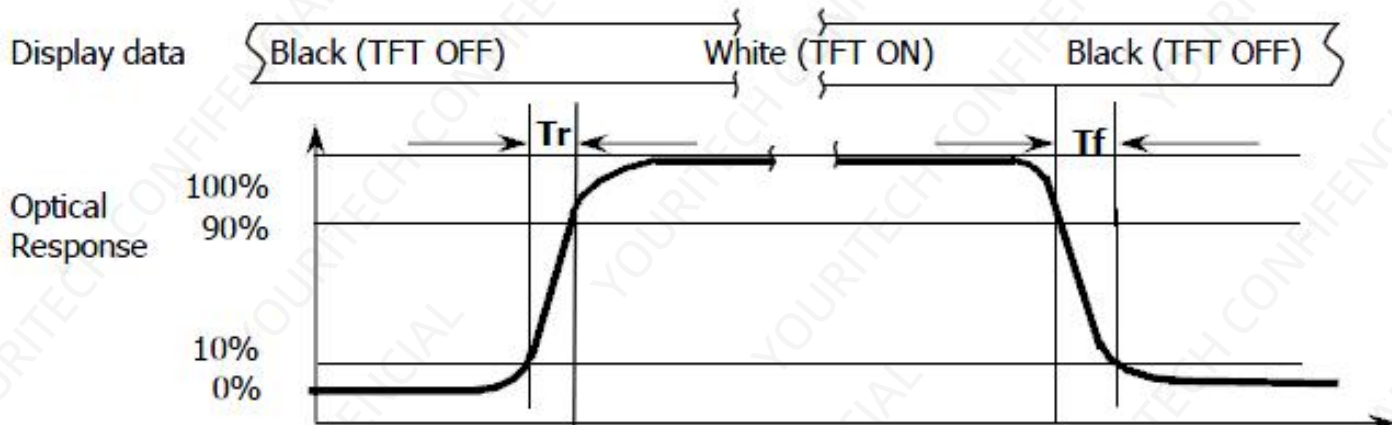
Note (1): Definition of Viewing Angle :



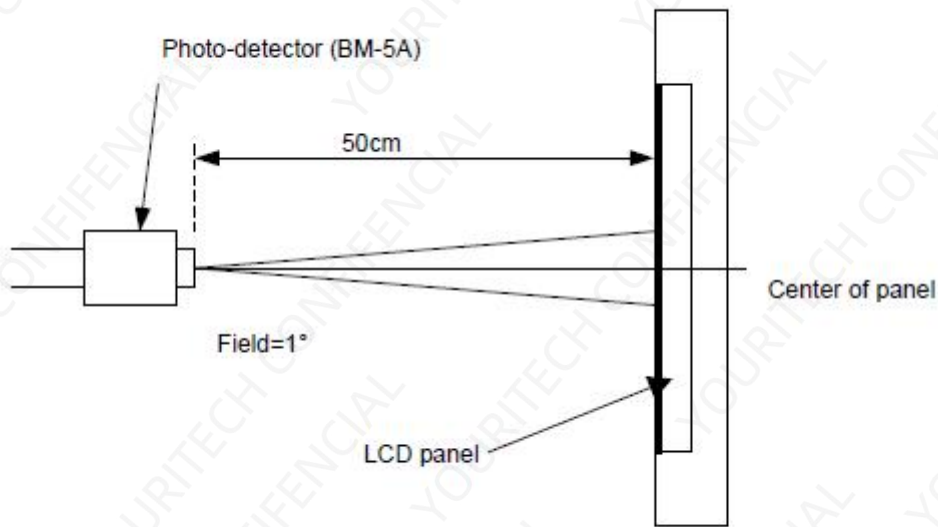
Note (2): Definition of Contrast Ratio(CR) :measured at the center point of panel

$$CR = \frac{\text{Luminance with all pixels white}}{\text{Luminance with all pixels black}}$$

Note (3): Response Time



Note (4): Definition of optical measurement setup



6. Electrical Characteristics

6.1 Absolute Maximum Rating

Characteristics	Symbol	Min.	Max.	Unit	Note
Digital Supply Voltage	V _{CI}	-0.3	4.6	V	Note1
Digital Interface Supply Voltage	IOVCC	-0.3	4.6	V	
Operating temperature	T _{OP}	-30	+85	°C	
Storage temperature	T _{ST}	-30	+85	°C	

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.

6.2 DC Electrical Characteristics

Characteristics	Symbol	Min.	Typ.	Max.	Unit	Note
Digital Supply Voltage	V _{CI}	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	



6.3 LED Backlight Characteristics

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

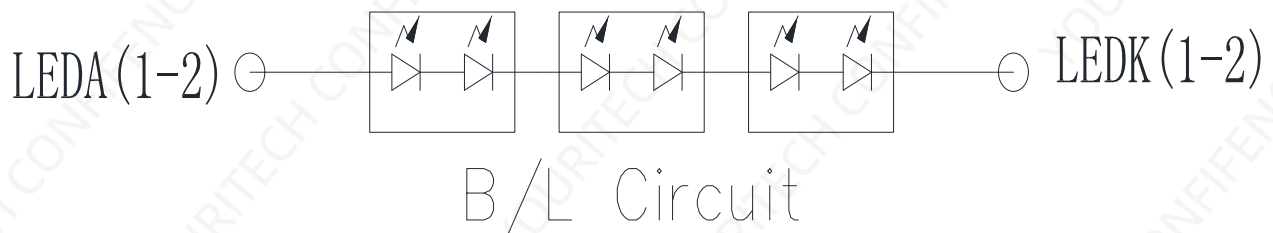
Item	Symbol	Min.	Typ.	Max.	Unit	Note
Forward Current	I_F	--	20	--	mA	
Forward Voltage	V_F	16.8	18.6	19.8	V	
LCM Luminance $I_F=20mA$	LV	770	920	--	cd/m ²	Note3
LED life time	Hr	30000	--	--	Hour	Note1,2
Uniformity	Avg	80	--	--	%	Note3

Note1: LED life time (Hr) can be defined as the time in which it continues to operate under the condition:

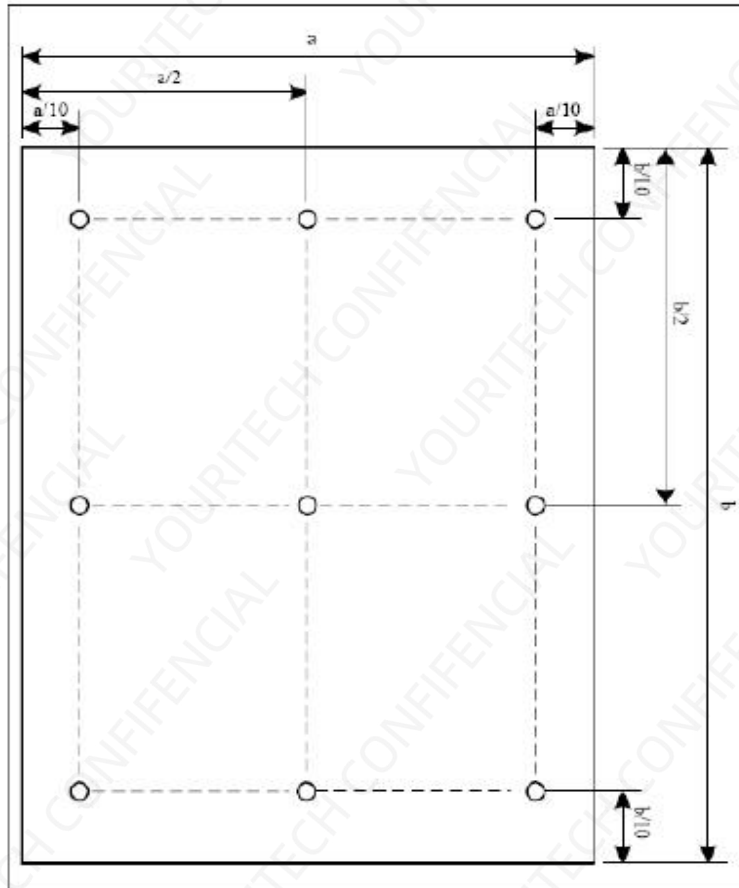
$T_a=25\pm3\text{ }^{\circ}\text{C}$, typical IL value indicated in the above table until the brightness becomes less than 50%.

Note 2: The “LED life time” is defined as the module brightness decrease to 50% original brightness at

$T_a=25^{\circ}\text{C}$ and $I_L=20mA$. The LED lifetime could be decreased if operating I_L is larger than 20mA. The constant current driving method is suggested.



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



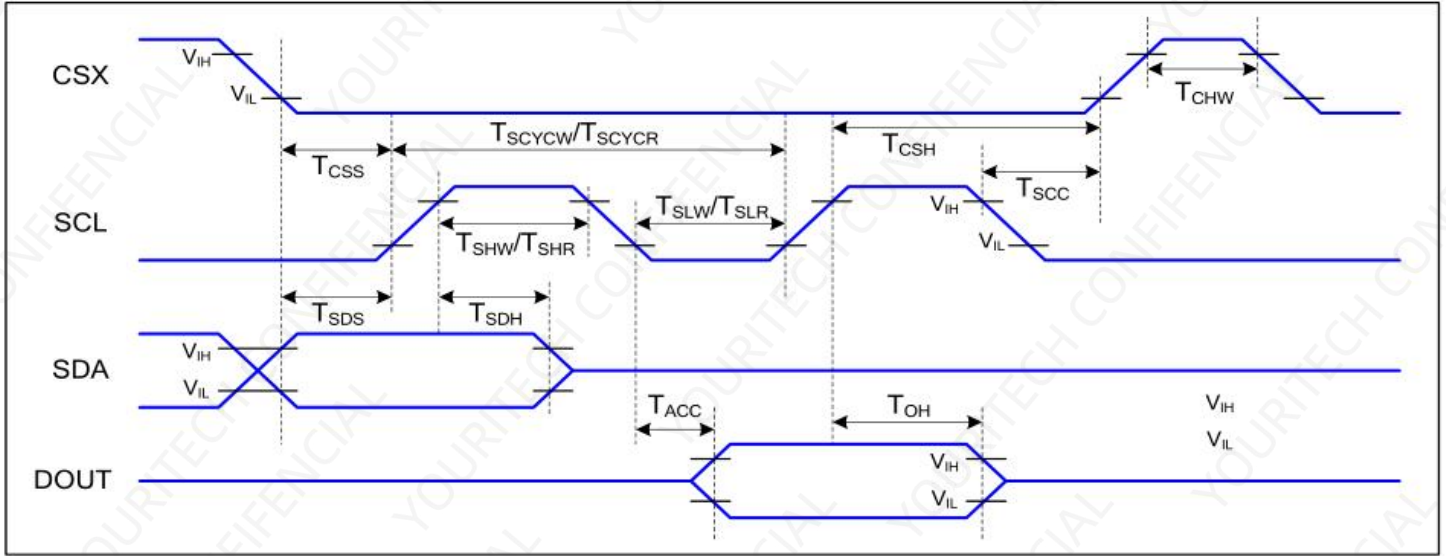
$$\text{Uniformity} = \frac{\text{minimum luminance in 9 points (1-9)}}{\text{maximum luminance in 9 points (1-9)}}$$

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



7. AC Characteristics

7.1 Serial Interface Characteristics (3-line serial):



3-line serial Interface Timing Characteristics

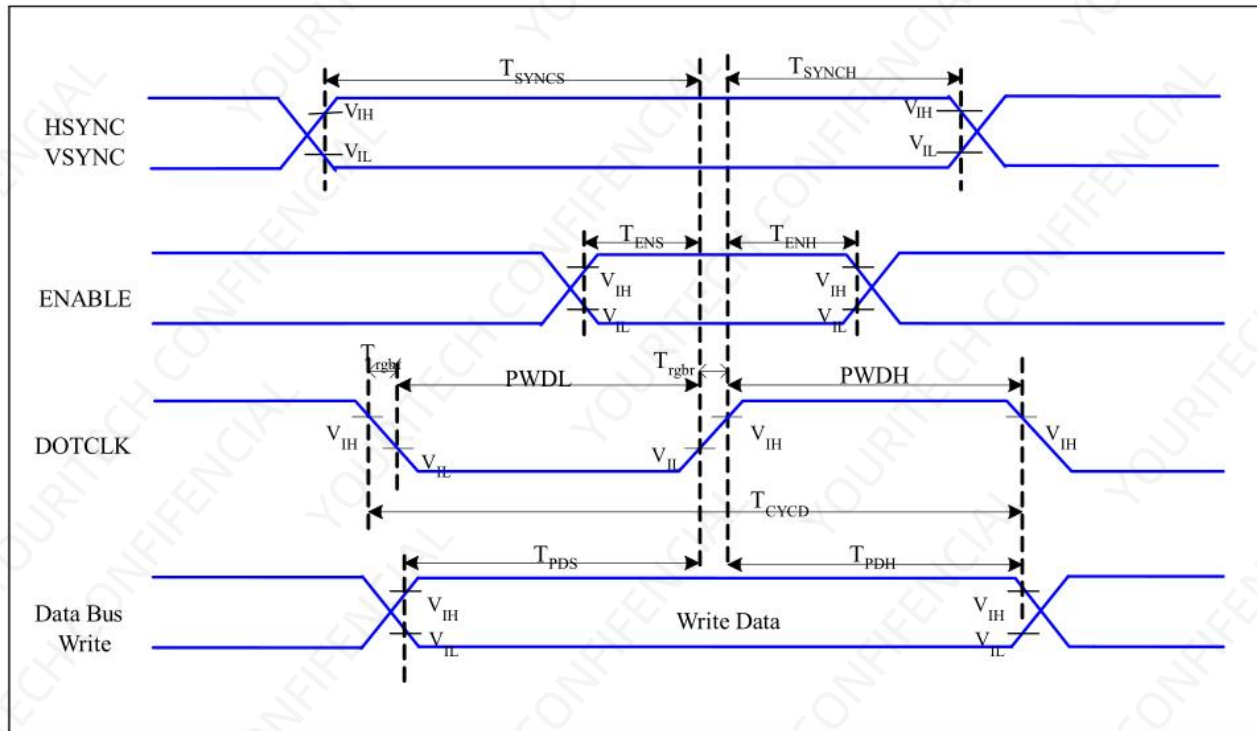
$IOVCC=1.8V, VCI=2.8V, Ta=25^{\circ}C$

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" 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 (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 $IOVCC$ for Input signals.



7.2. RGB Interface Characteristics :

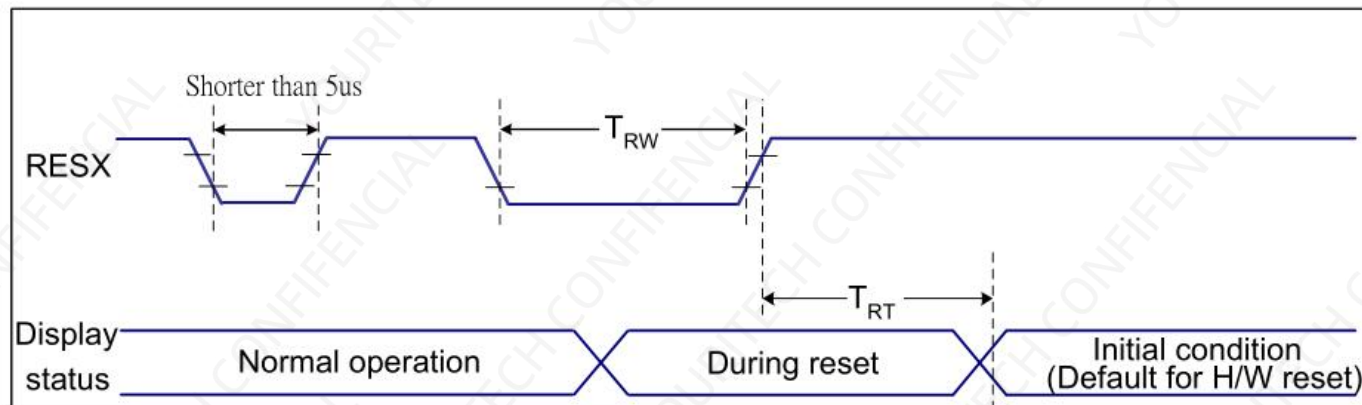


RGB Interface Timing Characteristics

Signal	Symbol	Parameter	MIN	MAX	Unit	Description
HSYNC, VSYNC	T_{SYNCS}	VSYNC, 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	
	$Trghr, Trghf$	DOTCLK Rise/Fall time	-	15	ns	
DB	T_{PDS}	PD Data Setup Time	5	-	ns	
	T_{PDH}	PD Data Hold Time	5	-	ns	



7.3 Reset input timing:



Reset Timing

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

Reset Timing

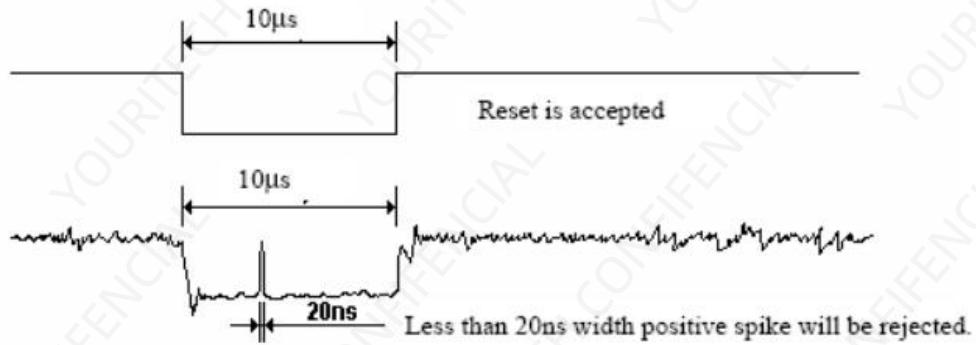
Notes:

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 (t_{RT}) within 5 ms after a rising edge of RESX.
2. Spike due to an electrostatic discharge on RESX line does not cause irregular system reset according to the table below:

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

3. During the Resetting period, the display will be blanked (The display is entering blanking sequence, which maximum time is 120 ms, 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 5msec after releasing RESX before sending commands. Also Sleep Out command cannot be sent for 120msec.



8. 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



8.1.1 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.

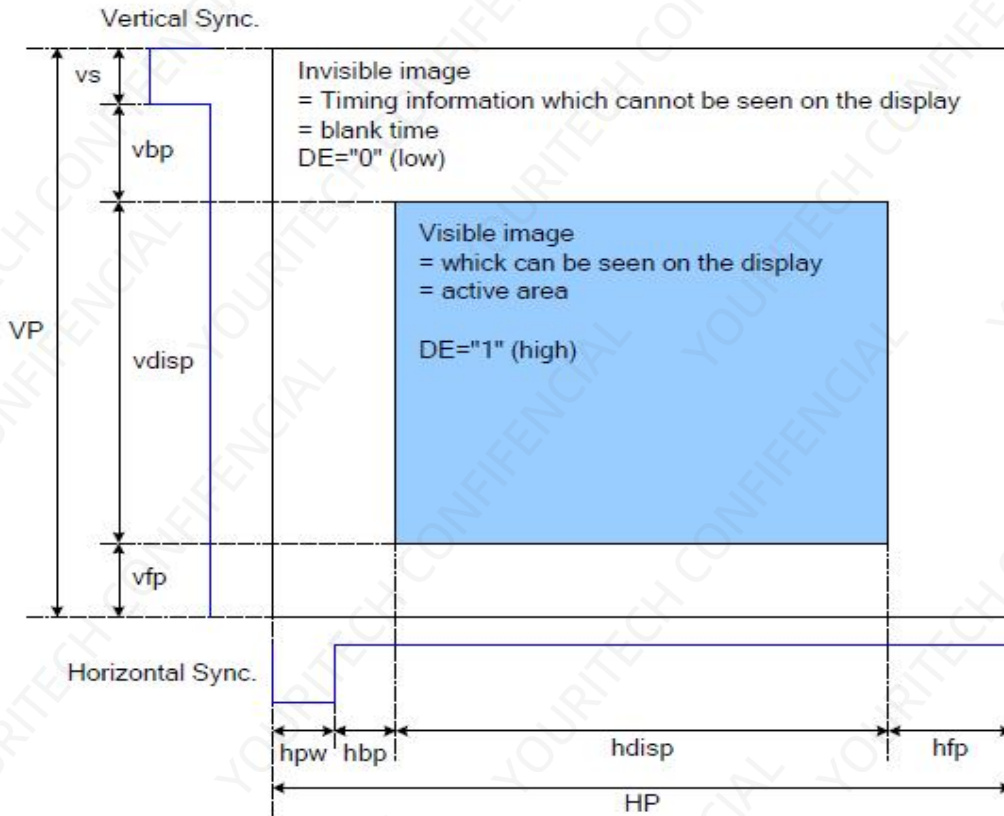
Pad name	24 bits configuration VIPF[3:0]=0111	18 bits configuration VIPF[3:0]=0110		16 bits configuration VIPF[3:0]=0101
		MDT=0	MDT=1	
DB[23]	R7	Not used	Not used	Not used
DB[22]	R6	Not used	Not used	Not used
DB[21]	R5	R5	Not used	Not used
DB[20]	R4	R4	Not used	R4
DB[19]	R3	R3	Not used	R3
DB[18]	R2	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



8.1.2 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	--	14	--	MHz
Horizontal Sync. Width	hpw	1	4	255	Clock
Horizontal Sync. Back Porch	hbp	1	42	255	Clock
Horizontal Sync. Front Porch	hfp	1	20	--	Clock
Vertical Sync. Width	vs	1	4	254	Line
Vertical Sync. Back Porch	vbp	1	44	254	Line
Vertical Sync. Front Porch	vfp	1	20	--	Line

sNote:

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



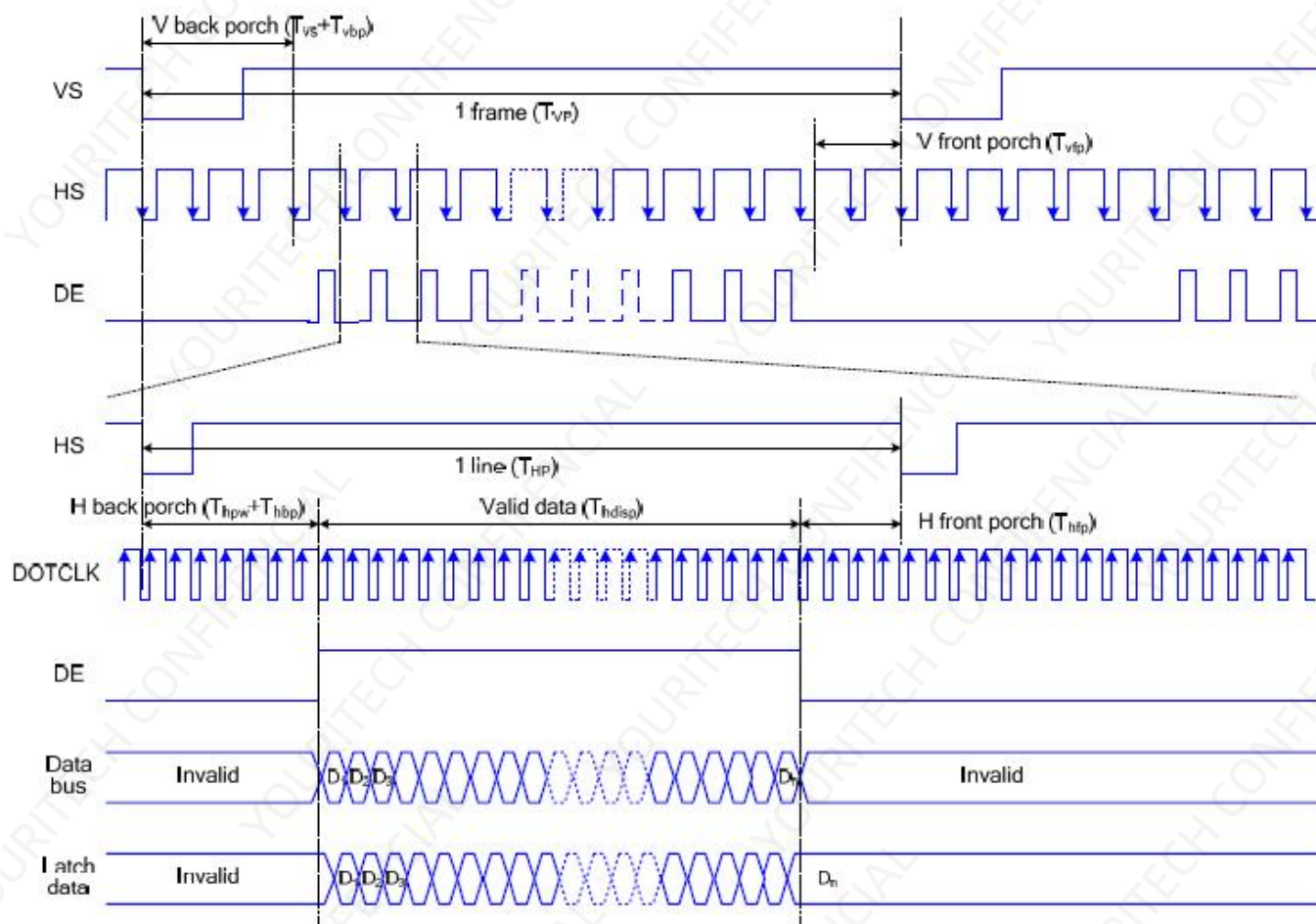
8.1.3 RGB Interface Mode Selection

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

8.1.4 RGB Interface Timing

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

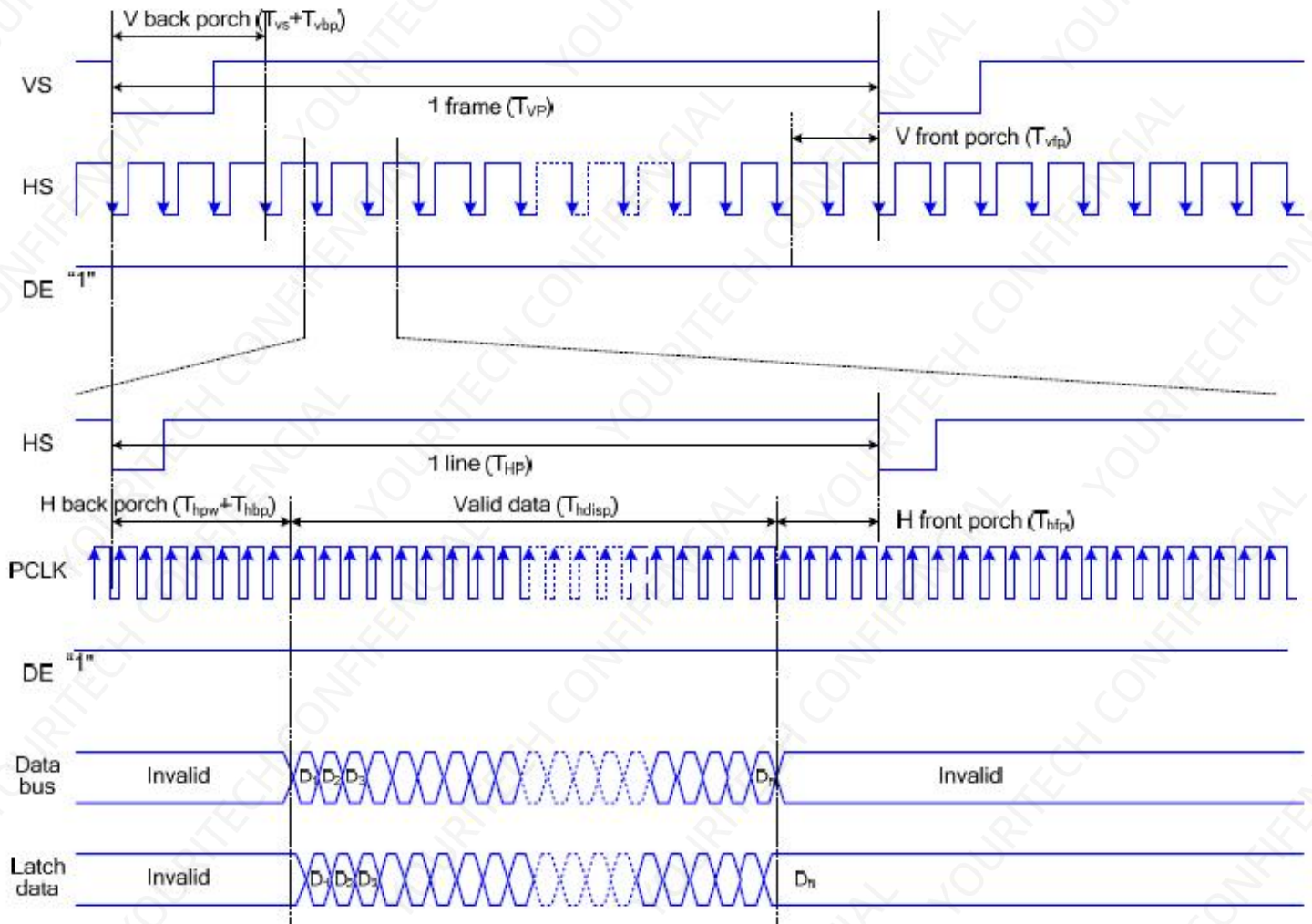


Note: The setting of front porch and back porch in host must match that in IC as this mode.

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



9. CTP Specification

9.1 Electrical Characteristics

9.1.1 Absolute Maximum Rating

Item	Symbol	Min.	Max.	Unit	Note
Power Supply Voltage	VDD	-0.3	3.6	V	1
I/O Digital Voltage	VDDIO	1.8	3.6	V	1

NOTES:

- If used beyond the absolute maximum ratings, FT5436 may be permanently damaged. It is strongly recommended that the device be used within the electrical characteristics in normal operations. If exposed to the condition not within the electrical characteristics, it may affect the reliability of the device.

9.1.2 DC Electrical Characteristics (Ta=25°C)

Item	Symbol	Condition	Min.	Typ.	Max.	Unit	Note
Digital supply voltage	VDD		2.8	3.3	3.6	V	
I/O Digital supply voltage	VDDIO		1.8	3.3	3.6	V	
Normal operation mode Current consumption	I _{opr}	VDD=2.8V Ta=25°C MCLK= 17.5Mhz	-	11	-	mA	
Monitor mode Current consumption	I _{mon}		-	0.43	-	mA	
Sleep mode Current consumption	I _{slp}		-	42	-	uA	
Level input voltage	V _{IH}		0.7V _{DDIO}	-	V _{DDIO}	V	
	V _{IL}		-0.3	-	0.3V _{DDIO}	V	
Level output voltage	V _{OH}	I _{OH} =-0.1mA	0.7V _{DDIO}	-	-	V	
	V _{OL}	I _{OH} =0.1mA	-	-	0.3V _{DDIO}	V	



9.2 POWER ON/Reset/Wake Sequence

The GPIO such as INT and I2C are advised to be low before powering on. Reset should be pulled down to be low before powering on. INT signal will be sent to the host after initializing all parameters and then start to report points to the host. If Power is down, the voltage of supply must be below 0.3V and Trst is more than 5ms.

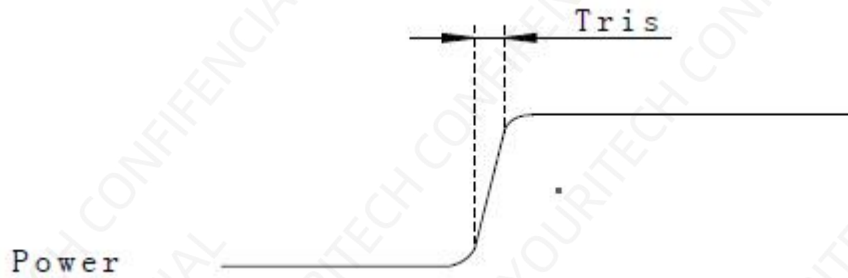


Figure 3-7 Power on time

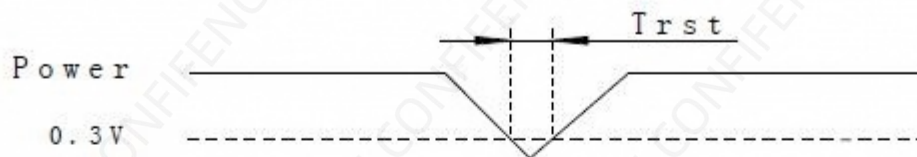


Figure 3-8 Power Cycle requirement

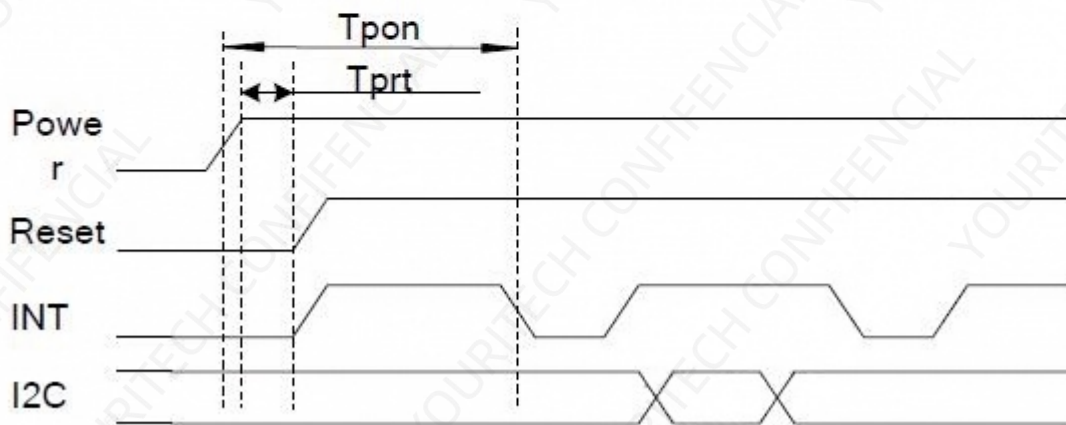


Figure 3-9 Power on Sequence

Reset time must be enough to guarantee reliable reset, the time of starting to report point after resetting approach to the time of starting to report point after powering on



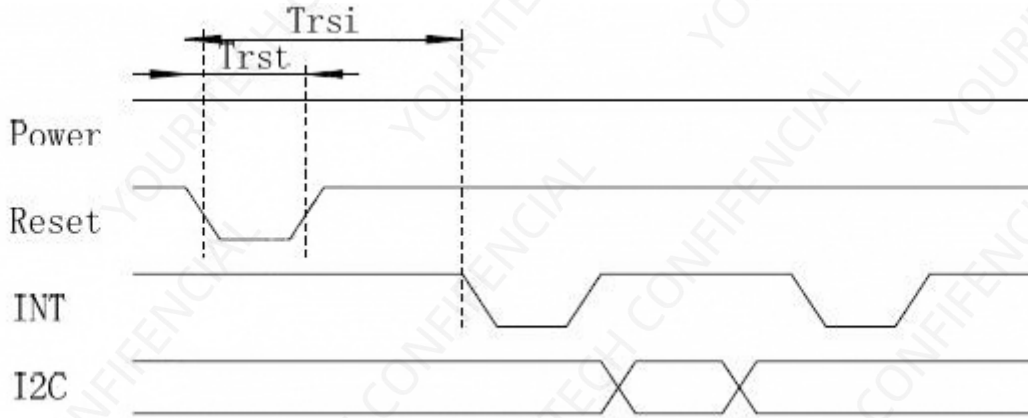


Figure 3-10 Reset Sequence

Table 3-5 Power on/Reset/Wake Sequence Parameters

Parameter	Description	Min	Max	Units
Tris	Rise time from 0.1VDD to 0.9VDD	-	3	ms
Tpon	Time of starting to report point after powering on	300	-	ms
Tprt	Time of being low after powering on	1	-	ms
Trsi	Time of starting to report point after resetting	300	-	ms
Trst	Reset time	5	-	ms



9.3 I2C Timing

FT5436 supports the I2C interfaces, which can be used by a host processor or other devices.

The I2C is always configured in the Slave mode. The data transfer format is shown in **Figure 2-4**.

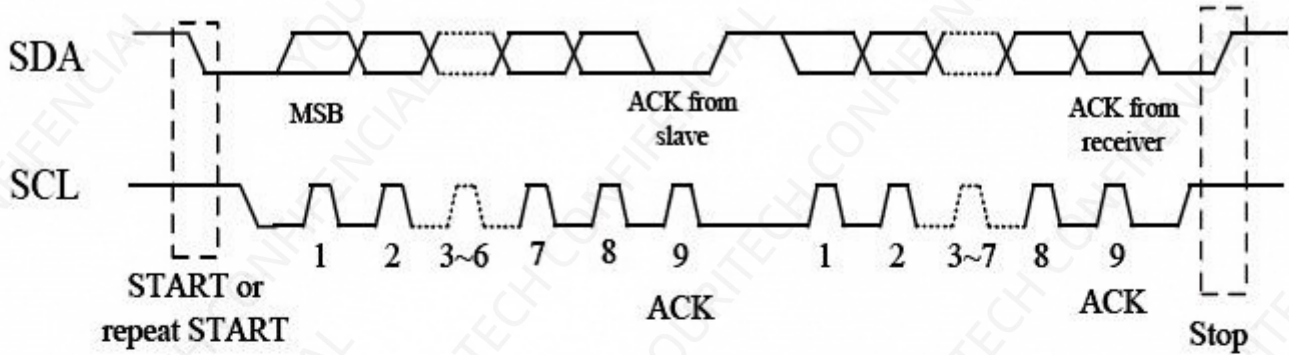


Figure 2-4 I2C Serial Data Transfer Format

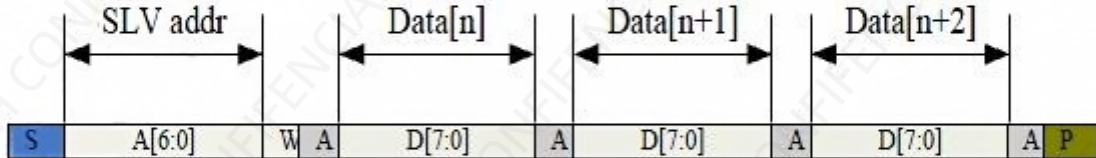


Figure 2-5 I2C master write, slave read

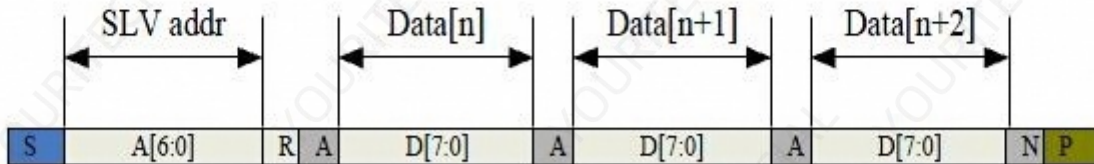


Figure 2-6 I2C master read, slave write

Table 2-1 lists the meanings of the mnemonics used in the above figures.

Table 2-1 Mnemonics Description



Mnemonics	Description
S	I2C Start or I2C Restart
A[6:0]	Slave address
R/ W	READ/WRITE bit, '1' for read, '0'for write
A(N)	ACK(NACK) bit
P	STOP: the indication of the end of a packet (if this bit is missing, S will indicate the end of the current packet and the beginning of the next packet)

I2C Interface Timing Characteristics is shown in Table 2-2.

Table 2-2 I2C Timing Characteristics

Parameter	Min	Max	Unit
SCL frequency	0	400	KHz
Bus free time between a STOP and START condition	1.3		us
Hold time (repeated) START condition	0.6		us
Data setup time	100		ns
Setup time for a repeated START condition	0.6		us
Setup Time for STOP condition	0.6		us



10. LCD Module Out-Going Quality Level

10.1 VISUAL & FUNCTION INSPECTION STANDARD

10.1.1 Inspection conditions

Inspection performed under the following conditions is recommended.

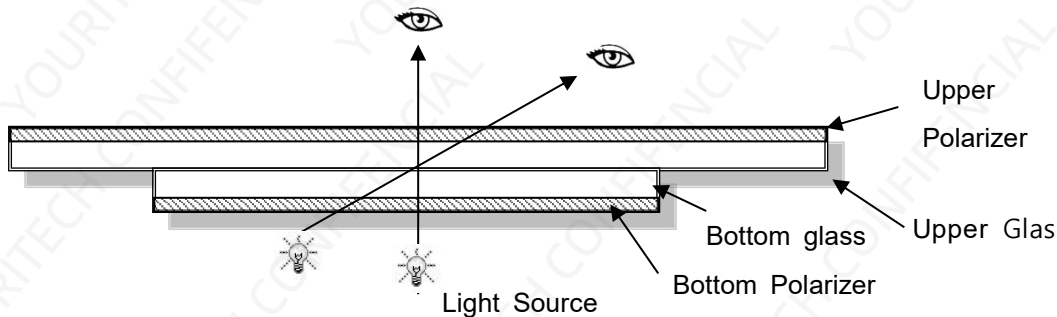
Temperature : $25\pm 5^{\circ}\text{C}$

Humidity : $65\%\pm 10\%\text{RH}$

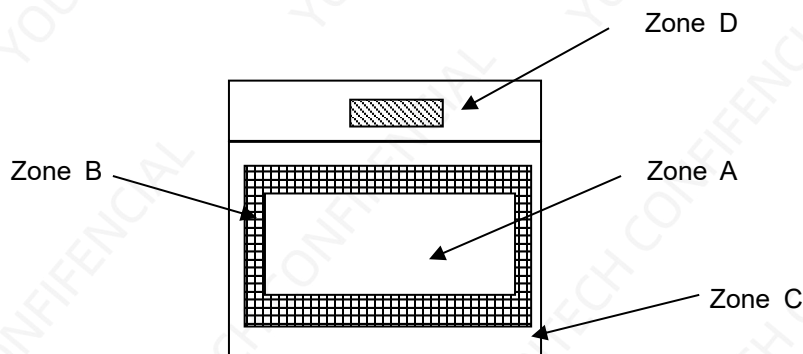
Viewing Angle : Normal viewing Angle.

Illumination: Single fluorescent lamp (300 to 700Lux)

Viewing distance:30-50cm



10.1.2 Definition



Zone A : Effective Viewing Area(Character or Digit can be seen)

Zone B : Viewing Area except Zone A

Zone C : Outside (Zone A+Zone B) which can not be seen after assembly by customer

Zone D : IC Bonding Area

Note:As a general rule ,visual defects in Zone C can be ignored when it doesn't effect product function or appearance after assembly by customer



10.1.3 Sampling Plan

According to GB/T 2828-2003 ; , normal inspection, Class II

AQL:

Major defect	Minor defect
0.65	1.5

LCD: Liquid Crystal Display , LCM: Liquid Crystal Module,

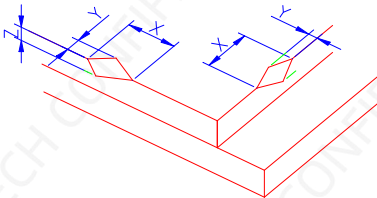
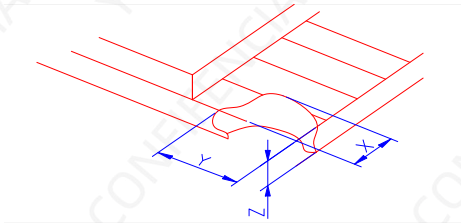
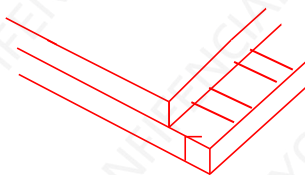
No	Items to be inspected	Criteria	Classification of defects
1	Functional defects	1) No display, Open or miss line 2) Display abnormally, Short 3) Backlight no lighting, abnormal lighting. etc...	Major
2	Missing	Missing components and etc...	
3	Outline dimension	Overall outline dimension beyond the drawing is not allowed, deformation and etc...	
4	Color tone	Color unevenness, refer to limited sample	Minor
5	Spot/Line defect	Light dot, Dim spot, (Note1) Polarizer Air Bubble, Polarizer accidented spot and etc.	
6	Soldering appearance	Good soldering , Peeling off is not allowed and etc.	
7	LCD/Polarizer	Black/White spot/line, scratch, crack, etc.	

Note1: a) Light dot: Dots appear bright and unchanged in size in which LCD panel is displaying under black pattern.

b) Dim dot: Dots appear dark and unchanged in size in which LCD panel is displaying under pure red, green, blue picture.



10.1.4 Criteria (Visual)

Number	Items	Criteria(mm)						
1.0 LCD Crack/Broken NOTE: X: Length Y: Width Z: Height L: Length of IT O, T: Height of LCD	(1) The edge of LCD broken	 <table><tr><td>X</td><td>Y</td><td>Z</td></tr><tr><td>≤3.0mm</td><td><Inner border line of the seal</td><td>≤T</td></tr></table>	X	Y	Z	≤3.0mm	<Inner border line of the seal	≤T
	X	Y	Z					
	≤3.0mm	<Inner border line of the seal	≤T					
(2)LCD corner broken	 <table><tr><td>X</td><td>Y</td><td>Z</td></tr><tr><td>≤3.0mm</td><td>≤L</td><td>≤T</td></tr></table>	X	Y	Z	≤3.0mm	≤L	≤T	
X	Y	Z						
≤3.0mm	≤L	≤T						
(3) LCD crack	 Crack Not allowed							



Spot defect

$$\Phi=(X+Y)/2$$

① light dot (black/white spot , pinhole, stain, etc.)

Zone Size (mm)	Acceptable Qty		
	A	B	C
$\Phi \leq 0.15$	Ignore	Ignore	
$0.15 < \Phi \leq 0.25$	3(distance $\geq 6\text{mm}$)		
$0.25 < \Phi \leq 0.4$	2(distance $\geq 6\text{mm}$)		
$\Phi > 0.4$	0		

② Dim spot (light leakage、dent、dark spot, etc)

Zone Size (mm)	Acceptable Qty		
	A	B	C
$\Phi \leq 0.15$	Ignore	Ignore	
$0.15 < \Phi \leq 0.25$	3(distance $\geq 6\text{mm}$)		
$0.25 < \Phi \leq 0.4$	2(distance $\geq 6\text{mm}$)		
$\Phi > 0.4$	0		

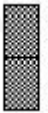
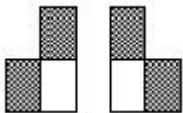
③ Polarizer accidented spot

Zone Size (mm)	Acceptable Qty			
	A	B	C	
$\Phi \leq 0.2$	Ignore		Ignore	
$0.2 < \Phi \leq 0.5$	2(distance $\geq 6\text{mm}$)			
$\Phi > 0.5$	0			

④Polarizer Bubble

Zone Size (mm)	Acceptable Qty			
	A	B	C	
$\Phi \leq 0.2$	Ignore		Ignore	
$0.2 < \Phi \leq 0.4$	3(distance $\geq 6\text{mm}$)			
$\Phi > 0.4$	0			



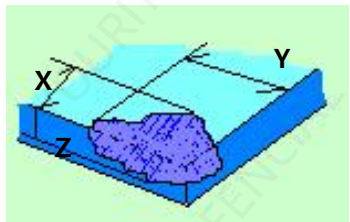
3.0	LCD Pixel defect	Pixel bad points <table data-bbox="539 309 1497 1059"> <tr> <th data-bbox="539 309 730 365">Item</th><th data-bbox="730 309 1246 365">Zone A</th><th data-bbox="1246 309 1497 365">Acceptable Qt</th></tr> <tr> <td data-bbox="539 365 730 521" rowspan="3">Bright dot</td><td data-bbox="730 365 1246 421">Random</td><td data-bbox="1246 365 1497 421">$N \leq 2$</td></tr> <tr> <td data-bbox="730 421 1246 477">2 dots adjacent</td><td data-bbox="1246 421 1497 477">$N \leq 0$</td></tr> <tr> <td data-bbox="730 477 1246 521">3 dots adjacent</td><td data-bbox="1246 477 1497 521">$N \leq 0$</td></tr> <tr> <td data-bbox="539 521 730 689" rowspan="3">Dark dot</td><td data-bbox="730 521 1246 577">Random</td><td data-bbox="1246 521 1497 577">$N \leq 2$</td></tr> <tr> <td data-bbox="730 577 1246 633">2 dots adjacent</td><td data-bbox="1246 577 1497 633">$N \leq 0$</td></tr> <tr> <td data-bbox="730 633 1246 689">3 dots adjacent</td><td data-bbox="1246 633 1497 689">$N \leq 0$</td></tr> <tr> <td data-bbox="539 689 730 1003">Distance</td><td data-bbox="730 689 1246 1003"> 1. Minimum Distance Between Bright dots. 2. Minimum Distance Between dark dots 3. Minimum Distance Between dark and bright dot. </td><td data-bbox="1246 689 1497 1003">5mm</td></tr> <tr> <td colspan="2" data-bbox="539 1003 1246 1059">Total bright and dark dot</td><td data-bbox="1246 1003 1497 1059">$N \leq 4$</td></tr> </table> Note: A) Bright dot: Dots appear bright and unchanged in size in which LCD panel is displaying under black pattern. B) Dark dot: Dots appear dark and unchanged in size in which LCD panel is displaying under pure red, green, blue picture. C) 2 dot adjacent = 1 pair = 2 dots Picture:  2 dot adjacent  2 dot adjacent (vertical)  2 dot adjacent  2 dot adjacent (slant)	Item	Zone A	Acceptable Qt	Bright dot	Random	$N \leq 2$	2 dots adjacent	$N \leq 0$	3 dots adjacent	$N \leq 0$	Dark dot	Random	$N \leq 2$	2 dots adjacent	$N \leq 0$	3 dots adjacent	$N \leq 0$	Distance	1. Minimum Distance Between Bright dots. 2. Minimum Distance Between dark dots 3. Minimum Distance Between dark and bright dot.	5mm	Total bright and dark dot		$N \leq 4$
Item	Zone A	Acceptable Qt																							
Bright dot	Random	$N \leq 2$																							
	2 dots adjacent	$N \leq 0$																							
	3 dots adjacent	$N \leq 0$																							
Dark dot	Random	$N \leq 2$																							
	2 dots adjacent	$N \leq 0$																							
	3 dots adjacent	$N \leq 0$																							
Distance	1. Minimum Distance Between Bright dots. 2. Minimum Distance Between dark dots 3. Minimum Distance Between dark and bright dot.	5mm																							
Total bright and dark dot		$N \leq 4$																							



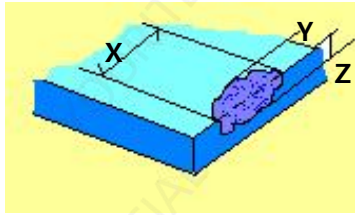
4.0	Line defect (LCD /Polarizer backlight black/white line, scratch, stain)				
					
	W: width, L : length				
	N : Count				
			</		

8.0	CTP Related	CTP Cover sensor acc identified black/white spot				
			Size Φ (mm)	Acceptable Qty		
				A	B	C
			$\Phi \leq 0.1$	Ignore		Ignore
			$0.1 < \Phi \leq 0.2$	3 (distance $\geq 6\text{mm}$)		
			$0.20 < \Phi \leq 0.25$	2 (distance $\geq 6\text{mm}$)		
$\Phi > 0.25$	0					



CTP Cover scratch	Width(mm)	Ignore (mm)	Acceptable Qty								
			A	B	C						
	$\Phi \leq 0.03$	Ignore	Ignore								
	$0.03 < W \leq 0.04$	$L \leq 3.0$	$N \leq 2$								
	$0.04 < W \leq 0.05$	$L \leq 2.0$	$N \leq 1$								
	$0.05 < W$	Define as spot defect									
CTP Cover Pinhole/ Lack of ink	Zone Size (mm)		Acceptable Qty								
			C								
	$\Phi \leq 0.1$	Ignore									
	$0.1 < \Phi \leq 0.25$	3(distance $\geq 6\text{mm}$)									
	$0.25 < \Phi \leq 0.3$	2(distance $\geq 6\text{mm}$)									
$\Phi > 0.3$	0										
CTP Bonding bubble/ accidented spot	Size $\Phi(\text{mm})$	Acceptable Qty									
		A	B								
	$\Phi \leq 0.1$	Ignore									
	$0.1 < \Phi \leq 0.2$	3(distance $\geq 6\text{mm}$)									
	$0.2 < \Phi \leq 0.25$	2(distance $\geq 6\text{mm}$)									
$\Phi > 0.25$	0										
Assembly deflection	beyond the edge of backlight $\leq 0.2\text{mm}$										
CTP cover broken X : length Y : width Z : height	<table><tr><td>X</td><td>Y</td><td>Z</td></tr><tr><td>$X \leq 0.5\text{mm}$</td><td>$Y \leq 0.5\text{mm}$</td><td>$Z < \text{cover t hickness}$</td></tr></table>			X	Y	Z	$X \leq 0.5\text{mm}$	$Y \leq 0.5\text{mm}$	$Z < \text{cover t hickness}$		
	X	Y	Z								
$X \leq 0.5\text{mm}$	$Y \leq 0.5\text{mm}$	$Z < \text{cover t hickness}$									
* Circuitry broken is not allowed.											



			X	Y	Z	
		CTP cover broken	$X \leq 0.3\text{mm}$	$Y \leq 0.3\text{mm}$	$Z < \text{cover thickness}$	
		X : length Y : width Z : height	* Circuitry broken is not allowed.			

Criteria (functional items)

Number	Items	Criteria (mm)
1	No display	Not allowed
2	Missing segment	Not allowed
3	Short	Not allowed
4	Backlight no lighting	Not allowed
5	CTP no function	Not allowed



11. Reliability Test Result

Item	Condition	Inspection after test
High Temperature Operating	85°C,96H	Inspection after 2~4hours storage at room temperature, the sample shall be free from defects: 1.Air bubble in the LCD; 2.Non-display; 3.Missing segments/line; 4.Glass crack; 5.Current IDD is twice higher than initial value.
Low Temperature Operating	-30°C, 96HR	
High Temperature Storage	85°C, 96HR	
Low Temperature Storage	-30°C, 96HR	
High Temperature & High Humidity Operating	+60°C, 90% RH ,96 hours.	
Thermal Shock (Non-operation)	-10°C,30 min ↔ +60°C,30 min, Change time:5min 20CYC.	
ESD test	C=150pF, R=330,5points/panel Air:±8KV, 5times; Contact:±6KV, 5 times; (Environment: 15°C~35°C, 30%~60%).	
Vibration (Non-operation)	Frequency range:10~55Hz, Stroke:1.5mm Sweep:10Hz~55Hz~10Hz 2 hours for each direction of X.Y.Z. (6 hours for total) (Package condition).	
Box Drop Test	1 Corner 3 Edges 6 faces,80cm(MEDIUM BOX)	

Remark:

- 1.The test samples should be applied to only one test item.
- 2.Sample size for each test item is 5~10pcs.
- 3.For Damp Proof Test, Pure water(Resistance > 10MΩ) should be used.
- 4.In case of malfunction defect caused by ESD damage, if it would be recovered to normal state after resetting, it would be judged as a good part.
- 5.Failure Judgment Criterion: Basic Specification, Electrical Characteristic, Mechanical Characteristic, Optical Characteristic.
6. The color fading mura of polarizing filter should not care.



12. Cautions and Handling Precautions

12.1 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 finger-stalls 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 6.1 Power On Sequence & 6.2 Power Off Sequence

12.2 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.

