



# **SPECIFICATION FOR LCD MODULE**

**MODULE NO: AFC480480A0-3.95INTM-C**

Customer's Approval:

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	SIGNATURE	DATE
PREPARED BY (RD ENGINEER)		
CHECKED BY		
APPROVED BY		

Date	Rev.	Description	Note	Page
2019-10-29	A	New issue	ZXM	

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# LCD MODULE

## 1. Features

Item	Standard Value
Display Type	480(RGB)*480 Dots
LCD Type	Color TFT, Transmissive
Screen Size(inch)	3.95寸
Viewing Direction	ALL
Backlight	White
Weight	TBD
Interface	RGB+SPI interface
Other(controller/driver IC)	ST7701S

## 2. Mechanical Specifications

Item	Standard Value	Unit
Outline Dimension	84(L)*84(W)*4.63(T)	mm
Active Area	71.856(L)*70.176(W)	mm
Dots Pitch	0.1497(H)×0.1462(V)	mm

## 3. Absolute Maximum Ratings

Item	Symbol	Condition	Min.	Max.	Unit
Power Supply Voltage	V <sub>DD</sub>	-	-0.3	4.6	V
Supply Voltage (Logic)	V <sub>DDI</sub>	-	-0.3	4.6	V
Operating Temperature	T <sub>OP</sub>	-	-20	70	°C
Storage Temperature	T <sub>ST</sub>	-	-30	80	°C
Humidity	-	T <sub>A</sub> ≤ 40°C	-	90	RH

#### 4. DC Electrical Characteristics

Item	Symbol	Condition	Min.	Typ.	Max.	Unit
Power Supply Voltage	V <sub>DDA</sub>	Operating Voltage	2.5	3.3	3.6	V
I/O Power supply	V <sub>DDI</sub>		1.35	1.8	3.3	
“H” Input Voltage	V <sub>IH</sub>	-	0.7V <sub>DDI</sub>	--	V <sub>DDI</sub>	V
“L” Input Voltage	V <sub>IL</sub>	-	VSS	--	0.3V <sub>DDI</sub>	V
“H” Output Voltage	V <sub>OH</sub>	-	0.8V <sub>DDI</sub>	--	V <sub>DDI</sub>	V
“L” Output Voltage	V <sub>OL</sub>	-	VSS	--	0.2V <sub>DDI</sub>	V
Supply Current	I <sub>DD</sub>	Normal	--	TBD	TBD	mA
TFT gate on voltage	V <sub>GH</sub>	--	--	15	--	V
TFT gate off voltage	V <sub>GL</sub>	--	--	-10	--	V
TFT common electrode voltage	V <sub>com</sub>	-	--	0	--	V
TFT operation frame rate	FV	-	--	--	--	Hz

#### 5. Optical Characteristics

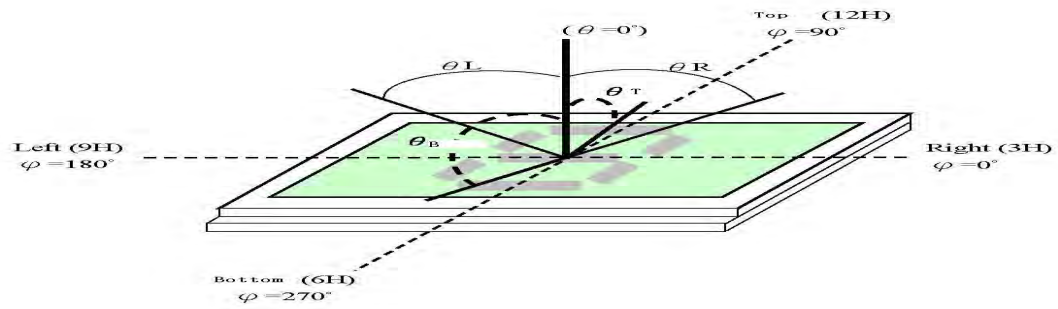
Item		Symbol	Conditions	Min.	Typ.	Max.	Reference
View Angle	Top	Θy+	C≥10	70	80	--	Notes 1 & 2
	Bottom	Θy-		70	80	--	
	Left	Θx+		70	80	--	
	Right	Θx-		70	80	--	
CIE *1	White	X	TA=25° Θx, ΘY=0°	--	TBD	--	Notes 5
		Y		--	TBD	--	
	Red	X		--	TBD	--	
		Y		--	TBD	--	
	Green	X		--	TBD	--	
		Y		--	TBD	--	
	Blue	X		--	TBD	--	
		Y		--	TBD	--	
Uniformity		%		70%	--	--	Note 4
Contrast Ratio		Cr	θY = 5°, Ø = 0°	640	800	--	Note 3
Surface Brightness		Cd/m²	Ø = 0°	--	350	--	Note 3 & 4
NTSC			CIE1931	55%	60%	--	-
Response Time		TR+ TF	Ø = 0°	--	25ms	35ms	Note 2

\*1: This value will be changed while mass product.

Note 1.

Optical characteristics-2

Viewing angle

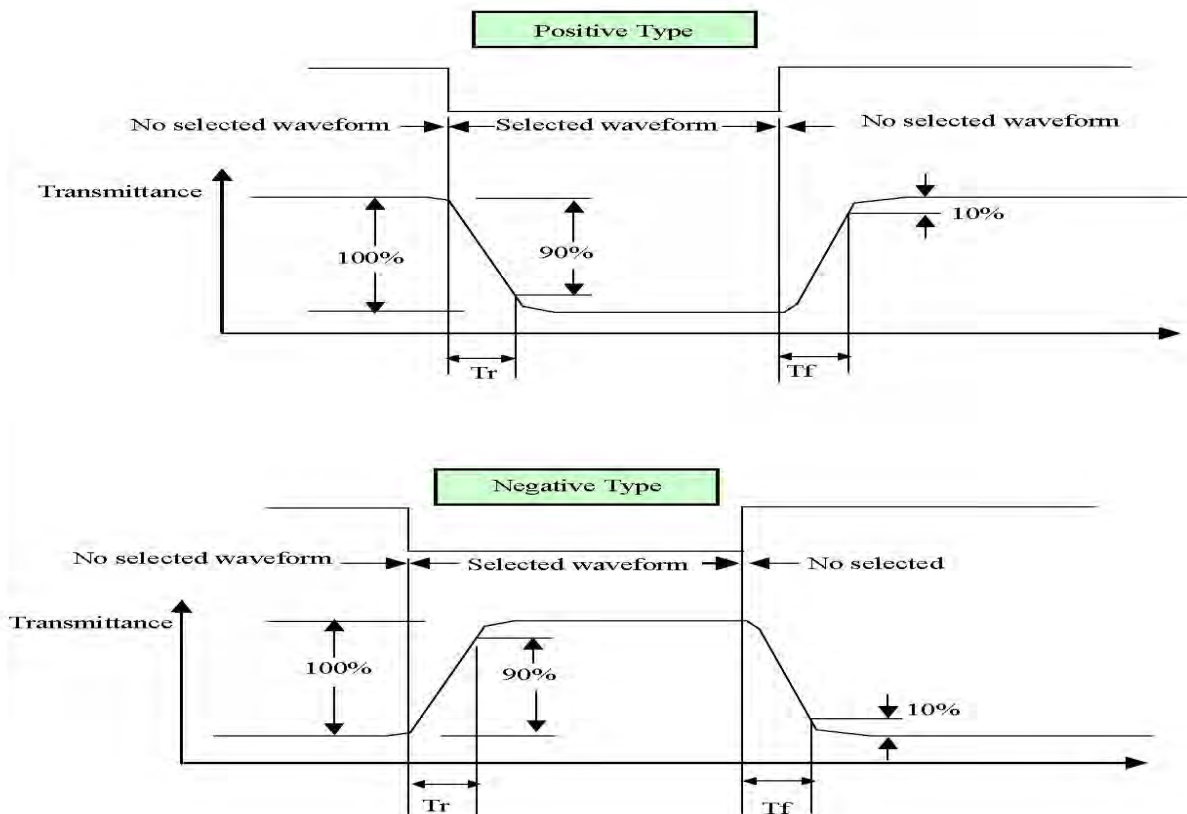


Viewing angle

Note 2.

Optical characteristics-3

Fig.2 Definition of response time



## Electrical characteristics-2

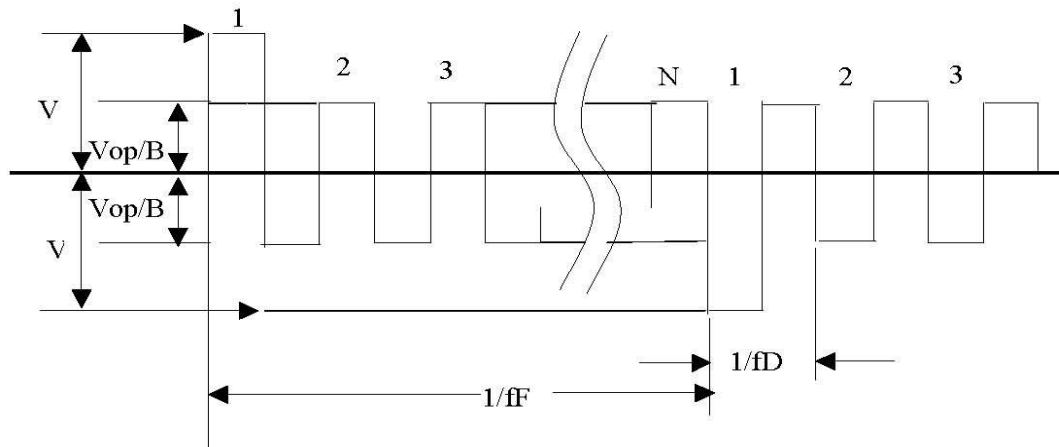
### ※2 Drive waveform

$V_{op}$ : Drive voltage       $f_F$ : Frame frequency

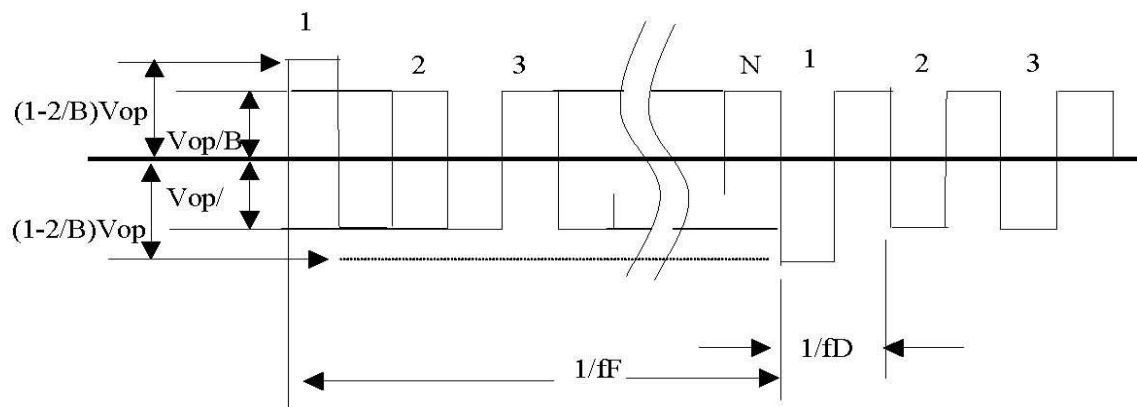
$1/B$ : Bias       $f_D$ : Drive frequency

$N$ : Duty

#### (1) Selected waveform



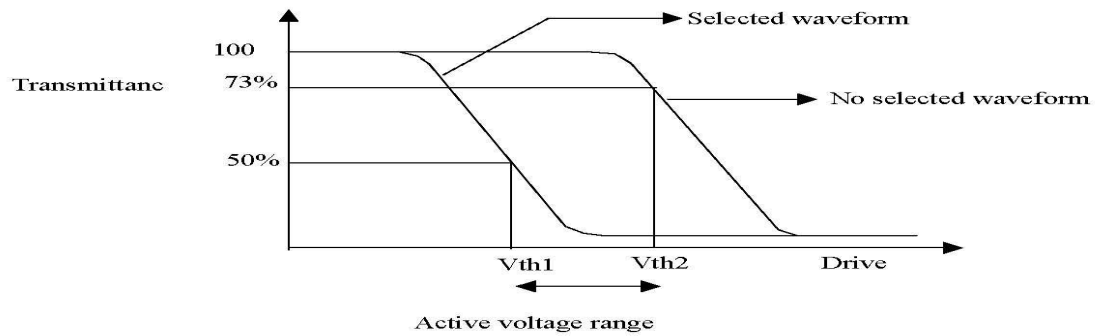
#### (2) Non- Selected wave form



Note:

Frame frequency is defined as follows: Common side supply voltage peak - to - peak / 2 = 1 period

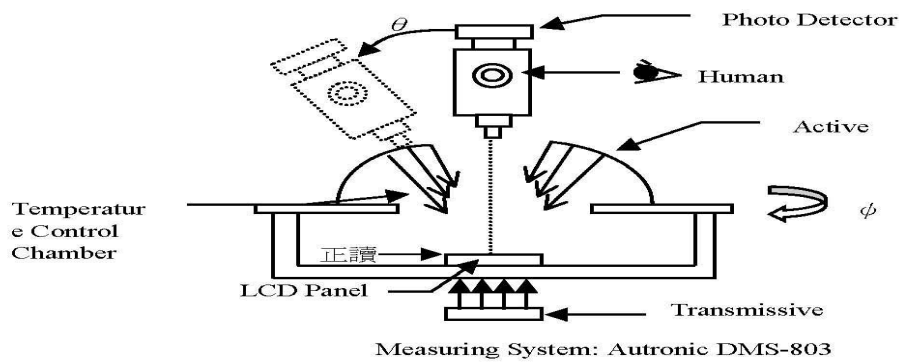
Note 3. : Definition of Vth



	Vth1	Vth2
View direction	10°	40°
Drive waveform	(Selected waveform)	(No selected waveform)
Transmittance	50%	73%

※1 Contrast ratio  
= (Brightness in OFF state) / (Brightness in ON state)

Outline of Electro-Optical Characteristics Measuring System



Note 4. Definition of Surface Luminance, Uniformity. (Ref Fig1)

Surface Luminance: LV=average (LP1:LP9)

Uniformity=Minimal (LP1:LP9)/Maximal (LP1:LP9)\*100%

Color Coordinate: The test condition is at IF current of backlight and measured on the surface of LCD module.

Note 5. CIE(x, y) chromaticity is the Center point value. (Ref Fig1)

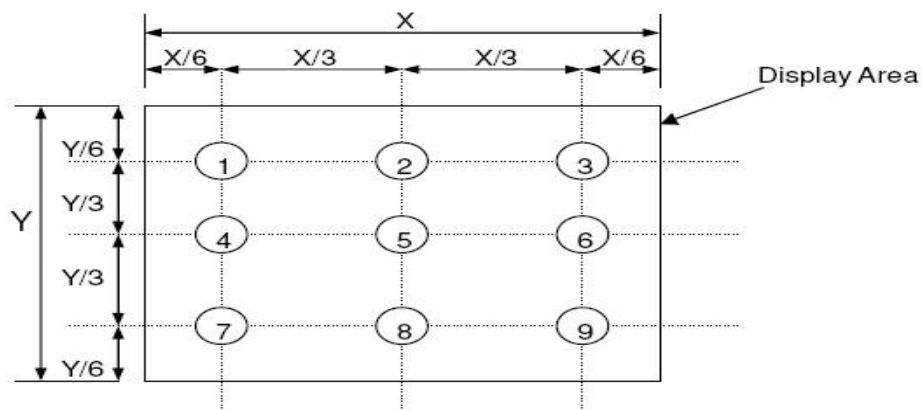


Fig1



## 6. Backlight Characteristics

Item	Symbol	Conditions	Min.	Typ.	Max.	Unit
Forward Voltage(ten LED)	V <sub>F</sub>		22.4	--	27.2	V
Forward Current	I <sub>F</sub>		--	20mA	--	mA
LED Life time (50% initial brightness)	Ta=25°C, IF=20mA		20000H minimum			
Color	WHITE					

## 7. Touch Panel Characteristics

### CTP

Item	Requirement
Touch Panel Type	Multi-Touch
Touch Controller IC	ST1633I
Cover Glass surface treatment	Without
Capacitive Touch structure	G+G
Cap Touch active area	68.46*68.73mm
Number of Sensor traces X (Tx)	12
Number of Sensor traces Y (Rx)	12
Cover Lens thickness	1.8mm
Air bonded to LCD	OCA
Interface	I2C
IO interface power (IOVDD)	3.3V
Normal IC power (VDD)	3.3V
Finger support	5 points

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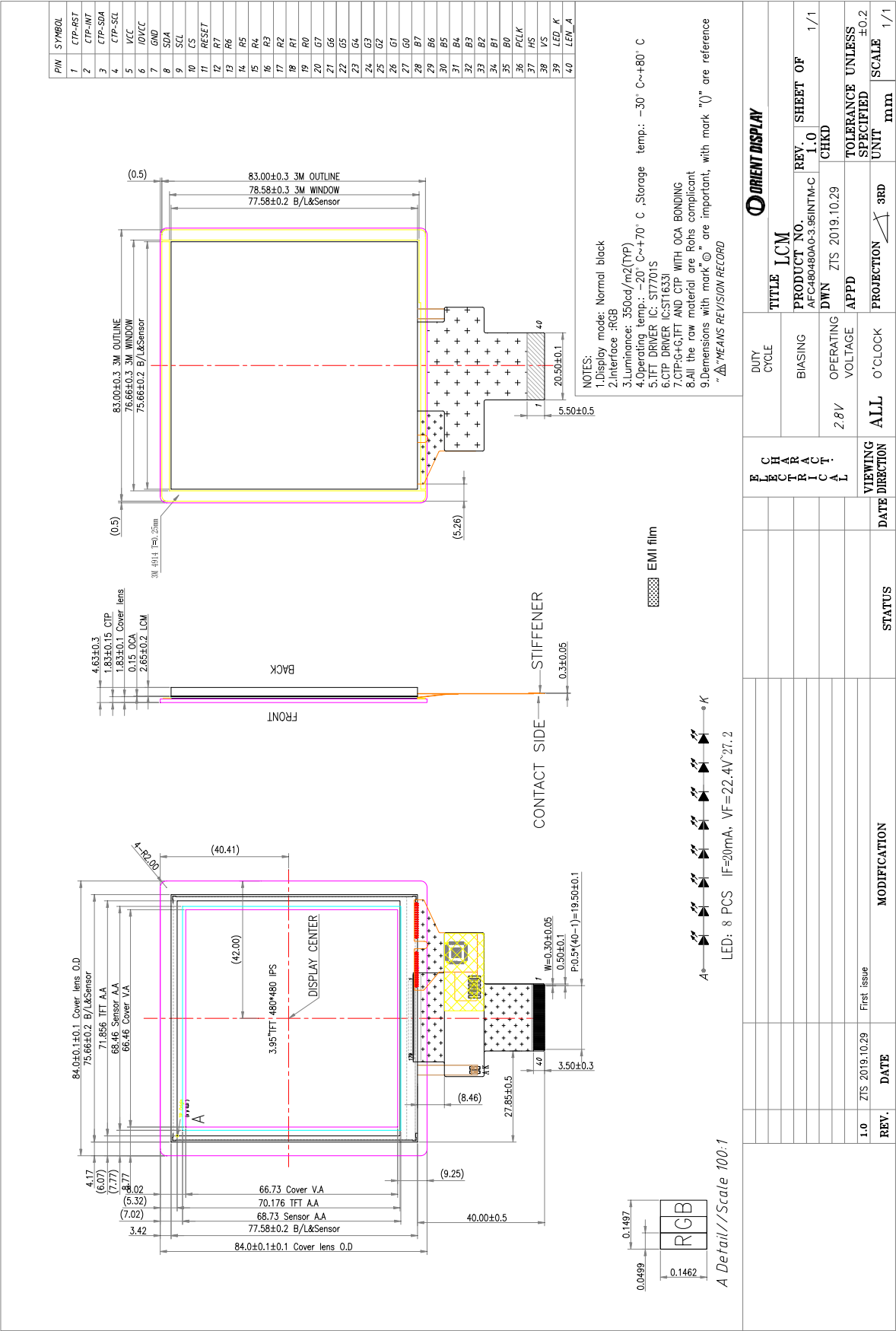
## 8. Interface Pin Description

Pin No.	Symbol	Function
1	CTP-RST	Touch Panel Control pin
2	CTP-INT	
3	CTP-SDA	
4	CTP-SCL	
5	VCC	Analog Power supply (to the analog circuit)
6	IOVCC	I/O Power supply ( to the digital circuit)
7	GND	Power Ground.
8	SDA	Serial data input/output bidirectional pin for SPI Interface
9	SCL	Serial clock input for SPI interface.
10	CS	chip select signal
11	RES	Reset input signal. Initialize the IC with a low input
12~19	R7~R0	24-bit parallel data bus for RGB Interface.
20~27	G7~G0	
28~35	B7~B0	
36	PCLK	Dot clock signal for RGB interface operation
37	HSYNC	Line synchronizing signal for RGB interface operation
38	VSYNC	Frame synchronizing signal for RGB interface operation
39	LEDK	BL LED (-)
40	LEDA	BL LED (+)

## 9. Block Diagram of Display

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10. Count Drawing



## 11. Timing Characteristics

### 7.5 AC Characteristics

#### 7.5.1 Serial Interface Characteristics (3-line serial):

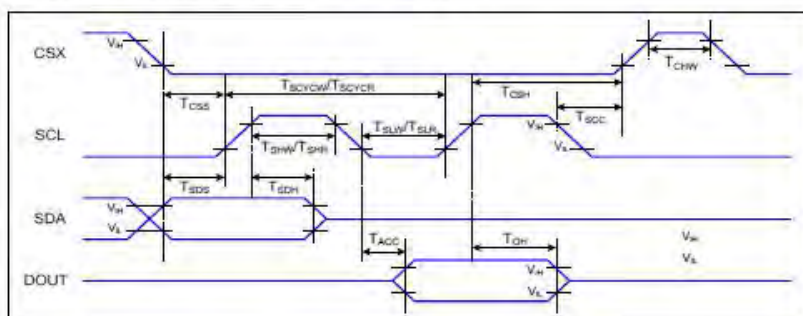


Figure 1 3-line serial Interface Timing Characteristics

VDD=1.8, VDD=2.8, AGND=DGND=0V, Ta=25°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	
	$T_{SCd}$	Chip select hold time (read)	60		ns	
	$T_{CHW}$	Chip select "H" pulse width	40		ns	
SCL	$T_{SCyW}$	Serial clock cycle (Write)	66		ns	
	$T_{SHW}$	SCL "H" pulse width (Write)	15		ns	
	$T_{SLW}$	SCL "L" pulse width (Write)	15		ns	
	$T_{SCyR}$	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 4 3-line serial Interface 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 50% and 70% of VDDI for Input signals.

#### 8.5.1 SPI interface pause

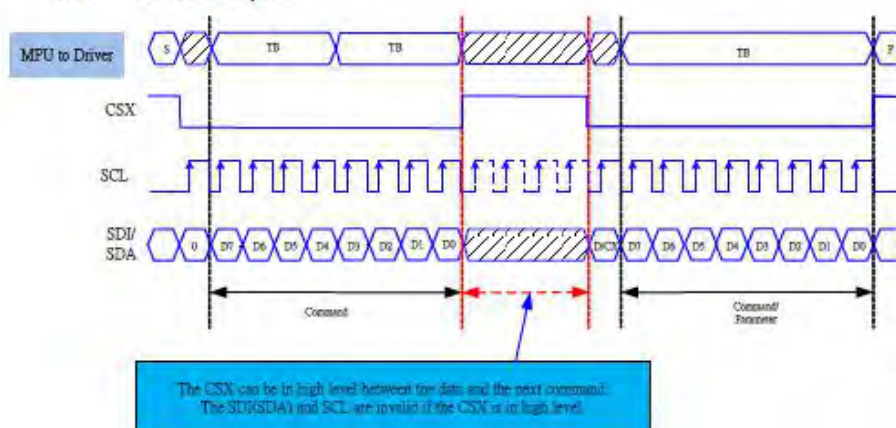


Figure 21 Serial Data Transfer Pause

This applies to the following 4 conditions:

- 1) Command-Pause-Command
- 2) Command-Pause-Parameter
- 3) Parameter-Pause-Command
- 4) Parameter-Pause-Parameter

### 7.5.3 RGB Interface Characteristics :

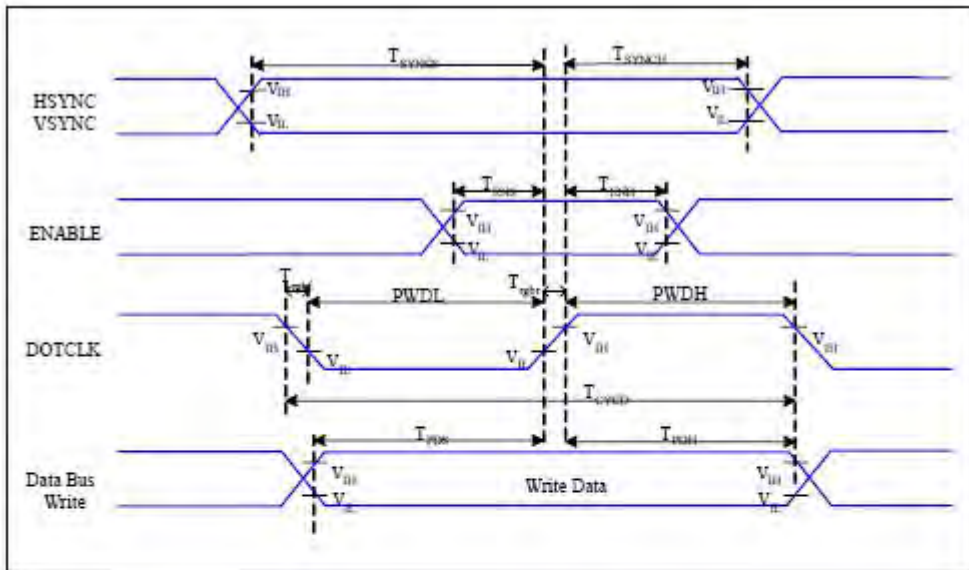


Figure 3 RGB Interface Timing Characteristics

VDD=1.8, VDD=2.8, AGND=DGND=0V, Ta=25 °C

Signal	Symbol	Parameter	MIN	MAX	Unit	Description
HSYNC, VSYNC	$T_{\text{SYNC}}$	VSNC, HSYNC Setup Time	5	-	ns	
ENABLE	$T_{\text{ENS}}$	Enable Setup Time	5	-	ns	
	$T_{\text{ENH}}$	Enable Hold Time	5	-	ns	
DOTCLK	$PWDH$	DOTCLK High-level Pulse Width	15	-	ns	
	$PWDL$	DOTCLK Low-level Pulse Width	15	-	ns	
	$T_{\text{CYCL}}$	DOTCLK Cycle Time	33	-	ns	
	$T_{\text{rghr}}, T_{\text{rghf}}$	DOTCLK Rise/Fall time	-	15	ns	
DB	$T_{\text{PDS}}$	PD Data Setup Time	5	-	ns	
	$T_{\text{PDH}}$	PD Data Hold Time	5	-	ns	

Table 6 18/16 Bits RGB Interface Timing Characteristics

## 8.6 RGB Interface

The ST7701S support RGB interface Mode 1 and Mode 2. The interface signals as shown in 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 ST7701S.

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

Table 11 The interface signals of RGB interface



### 8.6.1 RGB Color Format

ST7701S 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[23:0] pins can be used; when HV mode is selected and the VSYNC, HSYNC, DOTCLK, D[23:0] 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

Table 12 The interface color mapping of RGB interface

### 8.6.2 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.

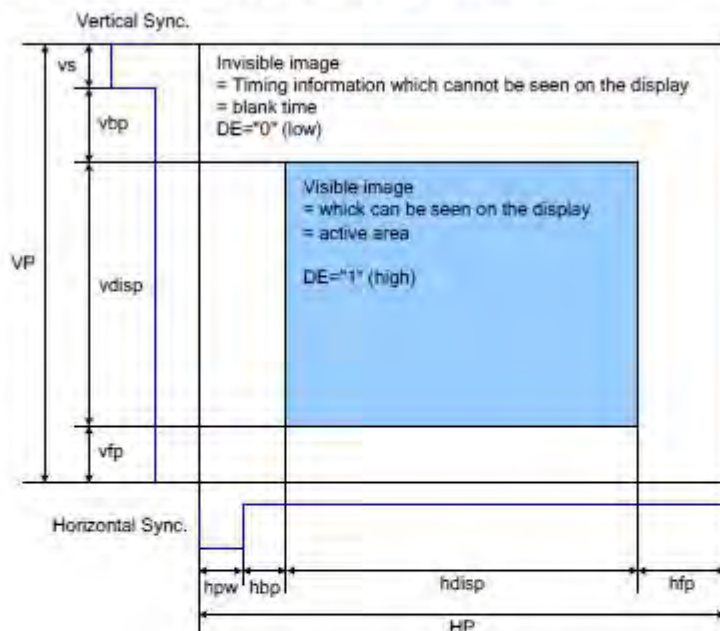


Figure 22 Access Area by RGB Interface

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

Parameter	Symbol	Min.	Typ.	Max.	Unit
Horizontal Sync. Width	hbw	1	—	255	Clock
Horizontal Sync. Back Porch	hbp	1	—	255	Clock
Horizontal Sync. Front Porch	hfp	1	—	—	Clock
Vertical Sync. Width	vs	1	—	254	Line
Vertical Sync. Back Porch	vbp	1	—	254	Line
Vertical Sync. Front Porch	vfp	2	—	—	Line

Note:

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



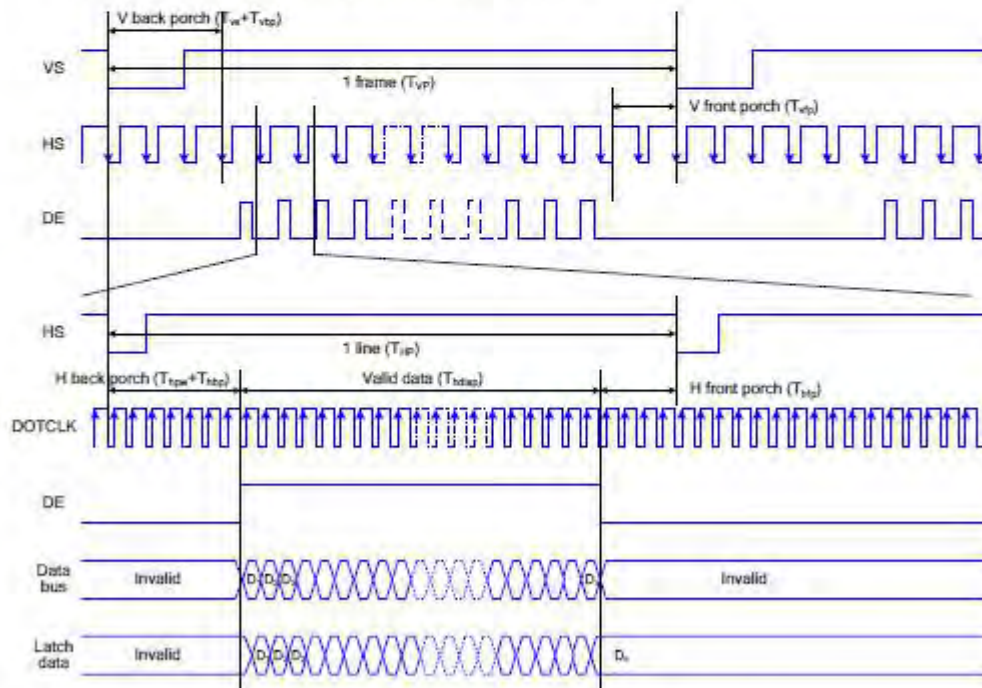
### 8.6.3 RGB Interface Mode Selection

ST7701S 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

### 8.6.4 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.

Figure 23 Timing Chart of Signals in RGB Interface DE Mode

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

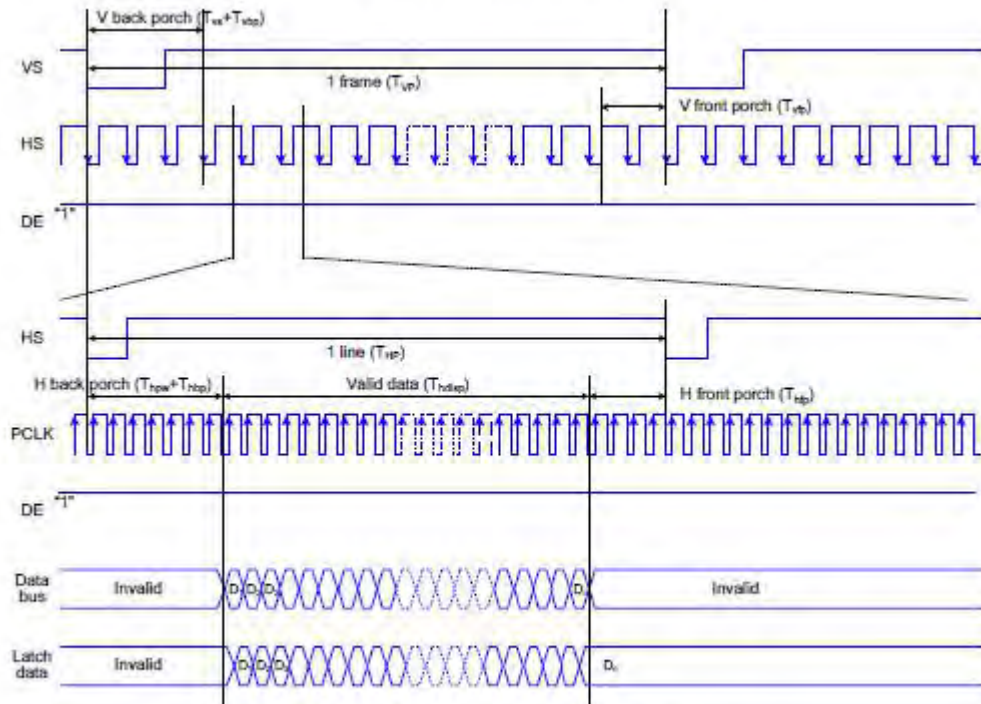


Figure 24 Timing chart of RGB interface HV mod

### 7.5.5 Reset Timing:

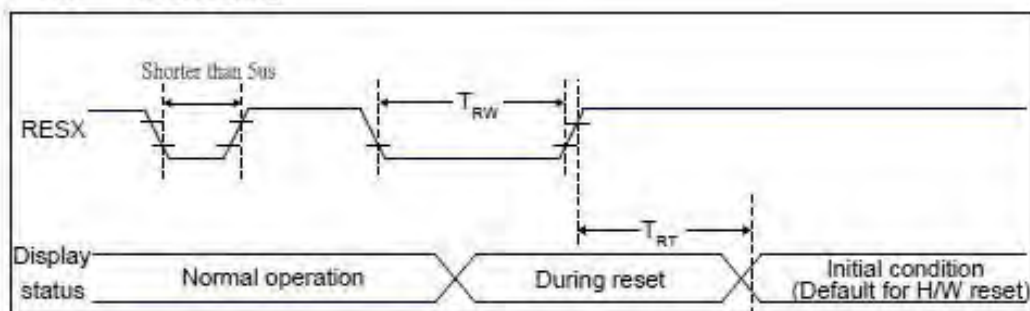


Figure 9 Reset Timing

VDD=1.8, VDD=2.8, AGND=DGND=0V, T<sub>a</sub>=25 °C

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

Table 9 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 (tRT) 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.

## 12. Reliability

NO	Item	Test Condition
1	High Temperature Storage	Storage at $80 \pm 2^{\circ}\text{C}$ 120 hrs Surrounding temperature, then storage at normal condition 4hrs
2	Low Temperature Storage	Storage at $-30 \pm 2^{\circ}\text{C}$ 120 hrs Surrounding temperature, then storage at normal condition 4hrs
3	High Temperature Operation	Operation at $70 \pm 2^{\circ}\text{C}$ 120 hrs
4	Low Temperature Operation	Operation at $-20 \pm 2^{\circ}\text{C}$ 120 hrs
5	High Temperature /Humidity Operating	Operation at $40 \pm 2^{\circ}\text{C}$ , 95%RH 240 hrs surrounding temperature, then storage at normal condition 4hrs.
6	Thermal shock (non-operation)	$  \begin{array}{c}  -20^{\circ}\text{C} \rightarrow 25^{\circ}\text{C} \rightarrow 70^{\circ}\text{C} \rightarrow 25^{\circ}\text{C} \\  (60\text{mins}) (5\text{mins}) (60\text{mins}) (5\text{mins}) \\  \longleftrightarrow 30 \text{ Cycle} \longrightarrow  \end{array}  $
7	Mechanical Test	Freq.: 10-55Hz Max. Acceleration: 5G X.Y.X. each direction For 10 mins.
		Drop them through 50cm height to strike horizontal plane
8	ESD Test	Air Discharge: Apply +/-12KV with 5 times Discharge for each polarity +/-
		Contact Discharge: Apply +/-8KV with 5 times Discharge for each polarity +/- 1. Temperature ambience: $15^{\circ}\text{C} \sim 35^{\circ}\text{C}$ 2. Humidity relative: 30%~60% 3. Energy Storage Capacitance( $C_s + C_d$ ): 150pF +/-10% 4. Discharge Resistance( $R_d$ ): $330\Omega$ +/-10% 5. Discharge, mode of operation: Single Discharge (time between successive discharges at least 1 sec) (Tolerance if the output voltage indication: +/-5%)

Note 1. For humidity test, DI water should be used

Inspection Standard: Inspect after 1-2hrs storage at room temperature, the sample shall be free from the following defects:

Air bubble in the LCD

Seal Leakage

Non-display

Missing Segment

Glass Crack

IDD is greater than twice initial value

Others as per QA Inspection Criteria

Note 2. No defect is allowed after testing.

Note 3. ESD should be applied to LCD glass panel, not other areas (such as on IC and so on)

IDD should be within twice initial value.

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.

Note 4. Only upon request.

## 13. Specification of Quality Assurance

### 13.1 Purpose

This standard for Quality Assurance assures the quality of LCD module products supplied to customer by Orient Display.

### 13.2 Standard for Quality Test

Orient Display performs the following tests to ensure the quality of product before shipment.

#### Sampling Plan:

GB/T2828.1-2003. Single sampling, Normal Inspection Level II.

Single sampling, normal inspection

#### Sampling Level:

Minor Defect: AQL 0.65%

Major Defect: AQL 0.15%.

#### Reliability Test:

Detailed requirement refer to Reliability Test Specification.

#### Nonconforming Analysis & Disposition

##### Nonconforming analysis

Customer should provide overall information of non-conforming sample for their complaints.

After receipt of detailed information from customer, the analysis of nonconforming parts usually should be finished in one week.

If Orient Display can not finish the analysis on time, customer will be notified with the progress status. Disposition of nonconforming:

Non-conforming product over ppm level will be replaced.

The cause of non-conformance will be analyzed. Corrective action will be discussed and implemented.

##### Agreement Items

Orient Display and customer shall negotiate if the following situation occurs

There is any discrepancy in standard of quality assurance.

Additional requirement to be added in product specification.

Any other special problem.

### 13.3 Standard of the Product Visual Inspection

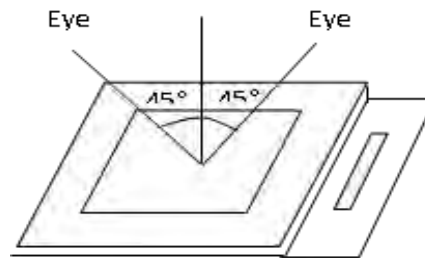
#### Appearance inspection

The normal inspection must be under illumination no less than 800lux, and the distance of view must be between 30cm and 45cm;

When inspect the model of transmissive product, back light must be lighted.

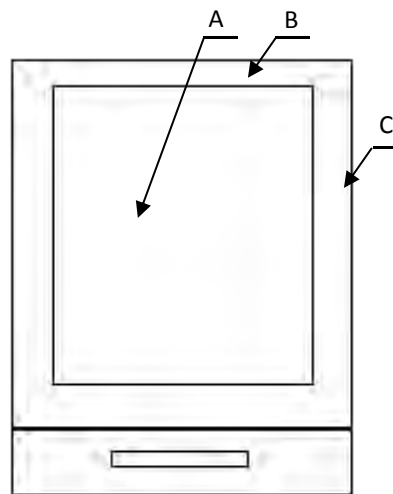
The visual viewing angle should be 45° from the vertical line without reflection shine or follows

customer's viewing angle specifications.



Definition of area( refer to product drawing)

A: Display area B: Viewing area C: Out of Viewing area



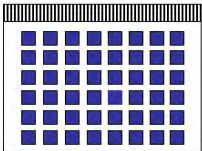
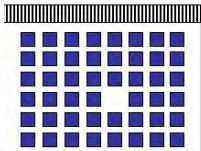
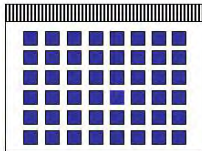
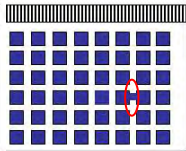
**Basic principle:**

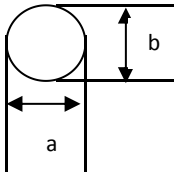
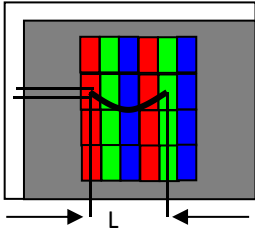
According to IPC standards if standard is not described in specification.

A set of sample to indicate the limit of acceptable quality level must be discussed by both Orient Display and customer when there is any dispute happened.

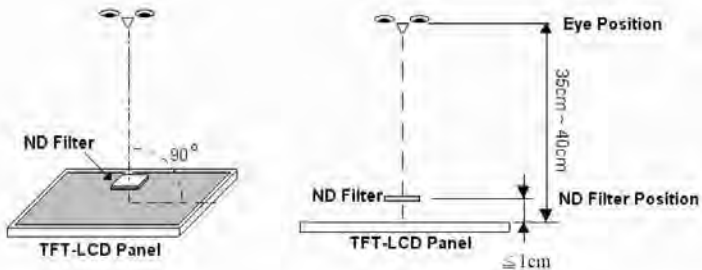
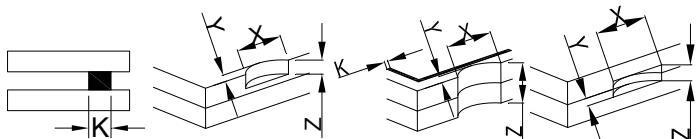
New item must be added on time when it is necessary.

### 13.4 Inspection Specification

No.	Item	Criteria (Unit: mm)		
Functional				
01	LC leakage	LC leakage	Reject	Maj
02	Non-display	Non-display	Reject	Maj
03	Missing segment/ Missing character, dot or icon.	<div> OK</div> <div> NG</div>	Reject	Maj
04	Exceeded dot/line/segment /Distortion	<div> OK</div> <div> NG</div>	Reject	Maj
05	Dim Display	part of figures display dim than normal obviously	As the samples confirmed each other	Min
06	Wrong view angle	View angle is different from spec.	Reject	Maj
07	Not light	1.Backlight not work 2. Some LED not light	Reject	Maj
08	Backlight Luminance \ uniformity	According to the product specification or limited samples	Reject	Min
09	Backlight Color	According to the product specification or limited samples	Reject	Min
10	CTP no response	CTP touch no response	Reject	Maj
11	Connection failure	FPC gold finger damage	Reject	Maj
Cosmetic				

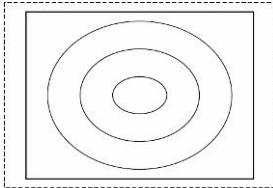

01	Black and white spot, Red, blue and green spot Dent Foreign material (Round type)	<div></div> <div><math>\varphi = (a + b) / 2</math></div> <table><tr><th rowspan="2">Size(mm)</th><th colspan="3">Area</th></tr><tr><th colspan="3">Acc. Qty</th></tr><tr><th></th><th>A</th><th>B</th><th>C</th></tr><tr><td><math>\varphi \leq 0.15</math></td><td colspan="2">Ignore</td><td>NC</td></tr><tr><td><math>0.15 &lt; \varphi \leq 0.3</math></td><td colspan="2">2</td><td>NC</td></tr><tr><td><math>0.30 &lt; \varphi \leq 0.5</math></td><td colspan="2">1</td><td>NC</td></tr><tr><td><math>\varphi &gt; 0.50</math></td><td colspan="2">0</td><td>NC</td></tr><tr><td>Total</td><td colspan="2">3</td><td>NC</td></tr></table> <div>Distance between 2 defects should more than 10 mm apart.</div>	Size(mm)	Area			Acc. Qty				A	B	C	$\varphi \leq 0.15$	Ignore		NC	$0.15 < \varphi \leq 0.3$	2		NC	$0.30 < \varphi \leq 0.5$	1		NC	$\varphi > 0.50$	0		NC	Total	3		NC	Min		
Size(mm)	Area																																			
	Acc. Qty																																			
	A	B	C																																	
$\varphi \leq 0.15$	Ignore		NC																																	
$0.15 < \varphi \leq 0.3$	2		NC																																	
$0.30 < \varphi \leq 0.5$	1		NC																																	
$\varphi > 0.50$	0		NC																																	
Total	3		NC																																	
02	Black and White line Scratch Foreign material (Line type) (Min)	<div></div> <table><tr><th rowspan="2">Length (mm)</th><th rowspan="2">Width (mm)</th><th colspan="3">Acc. Qty</th></tr><tr><th>A</th><th>B</th><th>C</th></tr><tr><td>/</td><td><math>W \leq 0.03</math></td><td colspan="2">Ignore</td><td>NC</td></tr><tr><td><math>L \leq 5</math></td><td><math>0.03 &lt; W \leq 0.05</math></td><td colspan="2">2</td><td>NC</td></tr><tr><td><math>L \leq 3</math></td><td><math>0.05 &lt; W \leq 0.1</math></td><td colspan="2">1</td><td>NC</td></tr><tr><td></td><td><math>W &gt; 0.10</math></td><td colspan="2">0</td><td>NC</td></tr><tr><td colspan="2">Total</td><td colspan="2">3</td><td>NC</td></tr></table> <div>Distance between 2 defects should more than 10mm apart.</div>	Length (mm)	Width (mm)	Acc. Qty			A	B	C	/	$W \leq 0.03$	Ignore		NC	$L \leq 5$	$0.03 < W \leq 0.05$	2		NC	$L \leq 3$	$0.05 < W \leq 0.1$	1		NC		$W > 0.10$	0		NC	Total		3		NC	Min
Length (mm)	Width (mm)	Acc. Qty																																		
		A	B	C																																
/	$W \leq 0.03$	Ignore		NC																																
$L \leq 5$	$0.03 < W \leq 0.05$	2		NC																																
$L \leq 3$	$0.05 < W \leq 0.1$	1		NC																																
	$W > 0.10$	0		NC																																
Total		3		NC																																
03	Polarizer concave and convex/bubbles	<table><tr><th rowspan="2">Diameter: <math>\Phi</math>(mm)</th><th colspan="3">Accept Qty</th></tr><tr><th>A</th><th>B</th><th>C</th></tr><tr><td><math>\Phi &lt; 0.2\text{mm}</math></td><td>Ignore</td><td rowspan="3">ignore</td><td rowspan="3">Ignore</td></tr><tr><td><math>0.2\text{mm} &lt; \Phi \leq 0.5\text{mm}</math></td><td>3</td></tr><tr><td><math>0.5\text{mm} &lt; \Phi \leq 0.7\text{mm}</math></td><td>2</td></tr><tr><td><math>\Phi &gt; 0.7\text{mm}</math></td><td colspan="2">Unacceptable</td></tr></table> <div>Distance between 2 defects should more than 10mm apart.</div>	Diameter: $\Phi$ (mm)	Accept Qty			A	B	C	$\Phi < 0.2\text{mm}$	Ignore	ignore	Ignore	$0.2\text{mm} < \Phi \leq 0.5\text{mm}$	3	$0.5\text{mm} < \Phi \leq 0.7\text{mm}$	2	$\Phi > 0.7\text{mm}$	Unacceptable		Min															
Diameter: $\Phi$ (mm)	Accept Qty																																			
	A	B	C																																	
$\Phi < 0.2\text{mm}$	Ignore	ignore	Ignore																																	
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$0.5\text{mm} < \Phi \leq 0.7\text{mm}$	2																																			
$\Phi > 0.7\text{mm}$	Unacceptable																																			
04	Bright/Dark dots, lines, Pixel defects	<div>*A dot is defined as a single sub-pixel (either red, green, or blue) within a pixel. Definition of Bright dots: Dots</div> <div>Allow</div>	Min																																	



		<table><tr><td>that can be seen through 6% ND filter.</td><td></td></tr><tr><td>Bright dots* (Min)</td><td>0</td></tr><tr><td>Adjacent bright dots</td><td>0</td></tr><tr><td>Dark dots*(Min)</td><td>2</td></tr><tr><td>Adjacent dark dots</td><td>0</td></tr><tr><td>Mura(50% GERY)</td><td>Judge by 6% ND filter, check with 30cm distance, if still can see, NG</td></tr><tr><td>Dark or Bright Lines</td><td>0</td></tr><tr><td>Blank pixel/ Missing pixel</td><td>Not allow</td></tr></table> <p>Remark: One pixel consists of 3 sub-pixels, including R,G and B dot(Sub-pixel=Dot)</p> <p>Note 1</p> <p>Bright dot is defined through 6% transmission ND filter as following:</p> <div></div> <p>Defects on the black Matrix, out of viewing area, aren't considered as a defect counted.</p>	that can be seen through 6% ND filter.		Bright dots* (Min)	0	Adjacent bright dots	0	Dark dots*(Min)	2	Adjacent dark dots	0	Mura(50% GERY)	Judge by 6% ND filter, check with 30cm distance, if still can see, NG	Dark or Bright Lines	0	Blank pixel/ Missing pixel	Not allow	
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Dark or Bright Lines	0																		
Blank pixel/ Missing pixel	Not allow																		
05	TFT Glass cracked	<p>Symbols</p> <p>X: Chip length                      Y: Chip width</p> <p>Z: Chip thickness                  K: Seal width</p> <p>T: Glass thickness                A: LCD side length/LCD</p> <p>L: Electrode pad length</p> <p>a) General glass chip</p> <p>1. Chip on panel surface and crack between panels</p> <div></div> <table><tr><td>Z: Chip thickness</td><td>Y: Chip width</td><td>X: Chip length</td></tr><tr><td><math>Z \leq 1/2T</math></td><td>Not expanded in</td><td><math>X \leq 1/8A</math></td></tr></table>	Z: Chip thickness	Y: Chip width	X: Chip length	$Z \leq 1/2T$	Not expanded in	$X \leq 1/8A$	Min										
Z: Chip thickness	Y: Chip width	X: Chip length																	
$Z \leq 1/2T$	Not expanded in	$X \leq 1/8A$																	


		same LCD	signed by customers or Orient Display	
07	FPC/FFC /TAB/HSC	Connect surface oxidation	Not allow	Maj
		Etching/damage /distortion	Not exceed 1/3 width of wire	Min
		Connect surface contamination /foreign material	Width & length of electric foreign material could not exceed the width of 2 pins	Min
		Connect surface scratch	The scratch depth not exceed 1/2 thickness of gold layer.	Min
		Copper/protective film/base board film separate	Not allow	Maj
		Others: FPC follow IPC-6013A standard.		
08	Soldering	Cold soldering , short soldering	Reject	Min
		Not enough solder paste	Solder paste area < 75% solder pad area Solder paste area < 75% component solder point Solder paste height < 1/2 component height	Min
		FPC Pin deviation	Deviation area > 1/3 Solder pad	Min
		Others: Follow IPC-A-610E standard		



13	RTP Newton ring	A Regular shape 	A: Newton ring area> 1/5 TP VA area Reject B: Newton ring area < 1/5 VA area and not affect the display and linearity during operation Accept	Min	
		B Irregular shape 	A: Newton ring area> 1/5 TP VA area Reject B: Newton ring affect the display and linearity during operation Reject C: Newton ring area < 1/5 VA area and not affect the display and linearity during operation Accept	Min	
14	Backlight	1.Spots or scratches that appear when light must be judged using LCD glass spot, line and contamination standards. 2.Brightness and Chromaticity can't be out of specification.		Min	
15	PCB	13.1 No distortion or contamination on PCB terminals. 13.2 All components on PCB must same as documented on the BOM/component layout. 13.3 Follow IPC-A-600F.		Min	
16	Bezel	a) No rust, distortion on the Bezel.		Min	
		b) No visible fingerprints, stains or other contamination.			
		Dent	1 mm>Ø>0.5 mm , 2	Accept	Min
			Ø≤0.5 mm	ignore	Min
		Exposed base metal material on front surface	Ø≤0.5 mm ,2 ↑	Accept	Min
		Exposed base meta material on side	Dot : Ø≤1.0mm , Line: L≤2.0mm、 W≤0.5mm	Accept	Min
Scratched	Exposed base metal material	Reject	Min		

### 13.5 RoHS Compliance

The product should RoHS Compliance.

## 14. Package Specification

*TBD*

## 15. Precaution for Using LCD Module

### 15.1 Handling Precaution

- 15.1.1 The display panel is made of glass and polarizer. As glass is fragile. It tends to become or chipped during handling especially on the edges. Please avoid dropping or jarring. Do not subject it to a mechanical shock by dropping it or impact.
- 15.1.2 If the display panel is damaged and the liquid crystal substance leaks out, be sure not to get any in your mouth. If the substance contacts your skin or clothes, wash it off using soap and water.
- 15.1.3 Do not apply excessive force to the display surface or the adjoining areas since this may cause the color tone to vary. Do not touch the display with bare hands, This will stain the display area and degraded insulation between terminals(some cosmetics are determined to the polarizer)
- 15.1.4 The polarizer covering the display surface of the LCD module is soft and easily scratched. Handle this polarizer carefully. Do not touch, push or rub the exposed polarizer with anything harder than an HB pencil lead (glass, tweezers, etc.). Do not put or attach anything on the display area to avoid leaving marks on it. Condensation on the surface and contact with terminals due to cold will damage, stain or dirty the polarizer. After products are tested at low temperature they must be warmed up in a container before coming in to contact with room temperature air.
- 15.1.5 If the display surface becomes contaminated, breathe on the surface and gently wipe it with a soft dry cloth. If it is heavily contaminated, moisten cloth with one of the following solvents, -Isotropy alcohol or Ethyl alcohol; do not scrub hard to avoid damaging the display surface.
- 15.1.6 Solvents other than those above-mentioned may damage the polarizer. Especially, do not use the following: water, Ketone, Aromatic solvents. Wipe off saliva or water drops immediately, contact with water over a long period of time may cause deformation or color fading. Avoid contact with oil and fats.
- 15.1.7 Exercise care to minimize corrosion of the electrode. Corrosion of the electrodes is accelerated by water droplets, moisture condensation or current flow in a high-humidity environment.
- 15.1.8 Install the LCD module by using the mounting holes. When mounting the LCD module make sure it is free of twisting, warping and distortion. In particular, do not forcibly pull or bend the I/O cable or the backlight cable.
- 15.1.9 Do not attempt to disassemble or process the LCD module.
- 15.1.10 NC terminal should be open. Do not connect anything.
- 15.1.11 If the logic circuit power is off, do not apply the input signals.
- 15.1.12 Electro-Static Discharge control, since this module uses a CMOS LSI, the same careful attention should be paid to electrostatic discharge as for an ordinary CMOS IC. To prevent destruction of the elements by static electricity, be careful to maintain an optimum work environment.
- 15.1.13 Since LCM has been assembled and adjusted with a high degree of precision, avoid applying excessive shocks to the module or making any alterations or modifications to it.

## 15.2 Storage Precaution

- 15.2.1 Store them in a sealed polyethylene bag. If properly sealed, there is no need for the desiccant.
- 15.2.2 Store them in a dark place. Do not expose to sunlight or fluorescent light, keep the temperature between 0°C and 35°C, and keep the relative humidity between 40% RH and 60% RH.
- 15.2.3 The polarizer surface should not come in contact with any other objects (we advise you to store them in anti-static electricity container in which they were shipped).
- 15.2.4 During shipment, please handle with care. The packaging bag can not be broken, step on trap. Packaging Carton layer height can not be over two meters.
- 15.2.5 The transportation process should pay attention to the waterproof and moisture-proof measures. Product can not be watering. Ethylene sealed bags can not be unsealed.
- 15.2.6 Liquid crystals solidify under low temperature (below the storage temperature range) leading to defective orientation or the generation of air bubbles (black or white). Air bubbles may also be generated if the module is subject to a low temperature.
- 15.2.7 If the LCD modules have been operating for a long time showing the same display patterns, the display patterns may remain on screen as ghost images and a slight contrast irregularity may also appear. A normal operating status can be regained by suspending use for some time. It should be noted that this phenomenon does not adversely affect performance reliability.
- 15.2.8 To minimize the performance degradation of the LCD modules resulting from destruction caused by static electricity etc.,

## 15.3 Using LCD Modules

- 15.3.1 The hole in the printed circuit board is used to fix LCM. Attend to the following items when installing the LCM. Cover the surface with a transparent protective plate to protect the polarizer and LC cell.
- 15.3.2 When assembling the LCM into other equipment, the spacer to the bit between the LCM and the fitting plate should have enough height to avoid causing stress to the module surface, refer to the individual specifications for measurements. The measurement tolerance should be  $\pm 0.1\text{mm}$ .
- 15.3.3 Precaution for assemble the module with BTB connector; Please note the position of the male and female connector position.
- 15.3.4 Precaution for soldering the LCM, Manual soldering temperature  $300\pm 20^{\circ}\text{C}$  , time is 3~5S.
- 15.3.5 If soldering flux is used, be sure to remove any remaining flux after finishing to soldering operation (This does not apply in the case of a non-halogen type of flux). It is recommended that you protect the LCD surface with a cover during soldering to prevent any damage due to flux spatters.
- 15.3.6 When soldering the electroluminescent panel and PC board, the panel and board should not be detached more than three times. This maximum number is determined by the temperature and time conditions mentioned above, though there may be some variance depending on the temperature of the soldering iron.
- 15.3.7 When remove the electroluminescent panel from the PC board, be sure the solder has completely

melted, the soldered pad on the PC board could be damaged.

## **15.4 Precautions for Operation**

- 15.4.1 Viewing angle varies with the change of liquid crystal driving voltage (VLCD). Adjust VLCD to show the best contrast.
- 15.4.2 It is an indispensable condition to drive LCD within the specified voltage limit since the higher voltage than the limit causes the shorter LCD life. An electrochemical reaction due to direct current causes LCD undesirable deterioration, so that the use of direct current drive should be avoided.
- 15.4.3 Response time will be extremely delayed at lower temperature than the operating temperature range and on the other hand at higher temperature LCD shows dark color in them. However those phenomena do not mean malfunction or out of order with LCD which will come back in the specified operating temperature.
- 15.4.4 If the display area is pushed hard during operation, the display will become abnormal. However, it will return to normal if it is turned off and back on.
- 15.4.5 Slight dew depositing on terminals is a cause for electro-chemical reaction resulting in terminal open circuit. Usage under the maximum operating temperature, 50%RH or less is required.
- 15.4.6 Input logic voltage before applying analog high voltage such as LCD driving voltage when power is on. Remove analog high voltage before logic voltage when power is off the module. Input each signal after the positive & negative voltage becomes stable.
- 15.4.7 Please keep the temperature within the specified range for use and storage. Polarization degradation, bubble generation or polarizer peel-off may occur with high temperature and high humidity.

## **15.5 Safety**

- 15.5.1 It is recommended to crush damaged or unnecessary LCD into pieces and wash them off with solvents such as acetone and ethanol, which should later be burned.
- 15.5.2 If any liquid leaks out of a damaged glass cell and comes in contact with the hands, wash off thoroughly with soap and water.

## **15.6 Limited Warranty**

- 15.6.1 Unless otherwise agreed between Orient Display and customer, Orient Display will replace or repair any of its LCD and LCM which Orient Display found to be defective electrically and visually when inspected in accordance with Orient Display quality standards, for a period of one year from date of shipment.
- 15.6.2 The warranty liability of Orient Display is limited to repair and/or replacement. Orient Display will not be responsible for any consequential loss.
- 15.6.3 If possible, we suggest you use up all modules in six months. If the module storage time over twelve months, we suggest that recheck it before the module is used.