

SPECIFICATION
FOR
LCM Module

MODULE No:	KD035LQFPA093-TP
CUSTOMER:	

STARTEK	INITIAL	DATE
PREPARED BY		
CHECKED BY		
APPROVED BY		

CUSTOMER	INITIAL	DATE
APPROVED BY		



Revision History

[illegible]

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常 备 库 存 Stock For Sale	长 期 供 货 Long Time supply	支持小量 NO MOQ	品 种 齐 全 In Full Range	

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* 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, back-light unit. The resolution of a 3.5" TFT-LCD contains 320x240 pixels, and can display up to 65K/262K/16.7M colors.

* Features

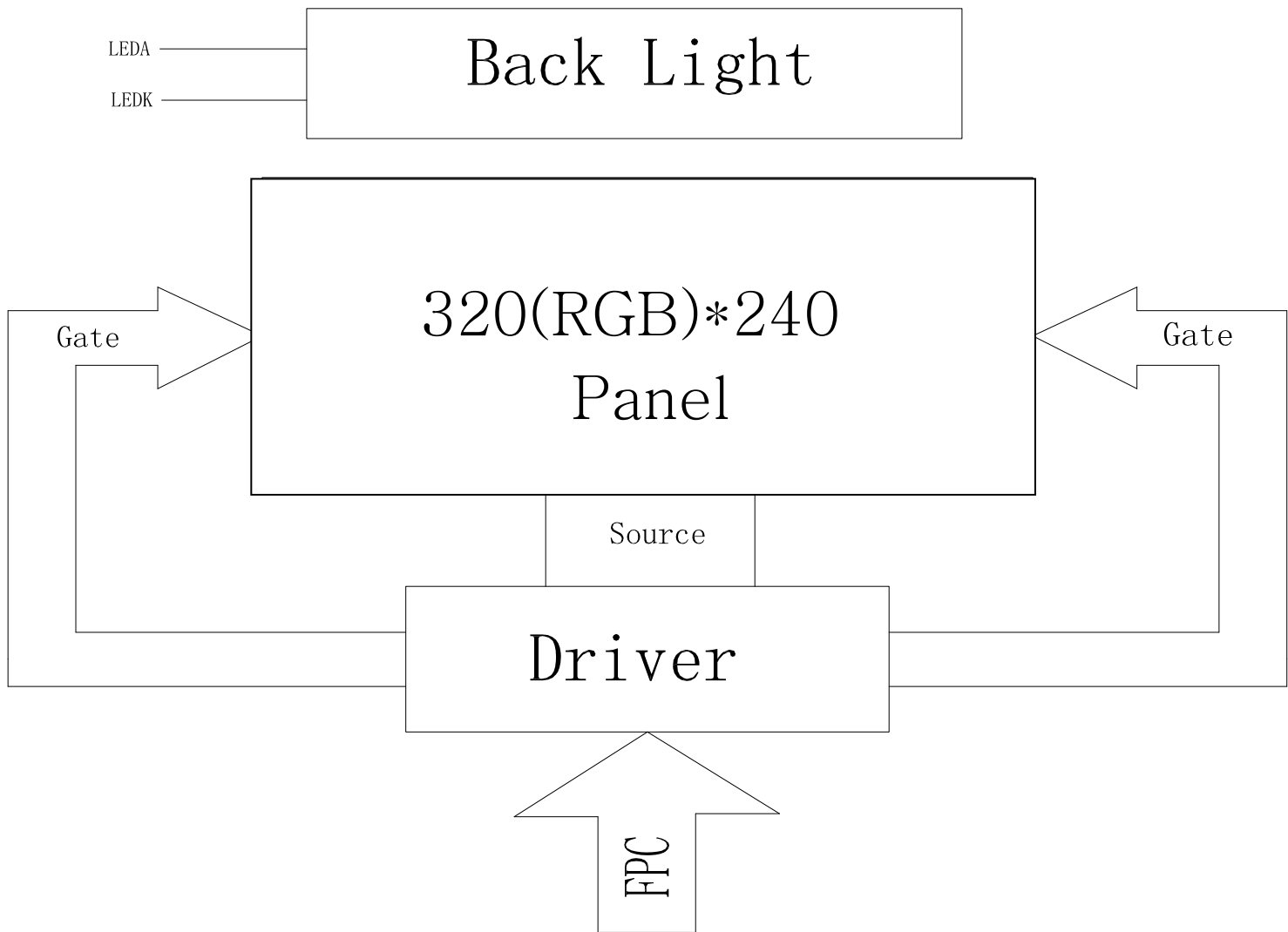
General Information Items	Specification	Unit	Note
	Main Panel		
Display area(AA)	70.08(H)*52.56(V) (3.5inch)	mm	
Driver element	TFT active matrix	-	
Display colors	65K/262K16.7M	colors	
Number of pixels	320(RGB)*240	dots	
Pixel arrangement	RGB vertical stripe	-	
Pixel pitch	0.219(H)*0.219(V)	mm	
Viewing angle	ALL	o'clock	
Controller IC	ST7272A	-	
LCM Interface	24BIT RGB	-	
Display mode	Transmissive /Normally black	-	
Operating temperature	-30~+85	°C	
Storage temperature	-40~+85	°C	

* Mechanical Information

Item		Min.	Typ.	Max.	Unit	Note
Module size	Horizontal(H)	-	76.9	-	mm	
	Vertical(V)	-	63.9	-	mm	
	Depth(D)	-	4.32	-	mm	
Weight		-	TBD	-	g	

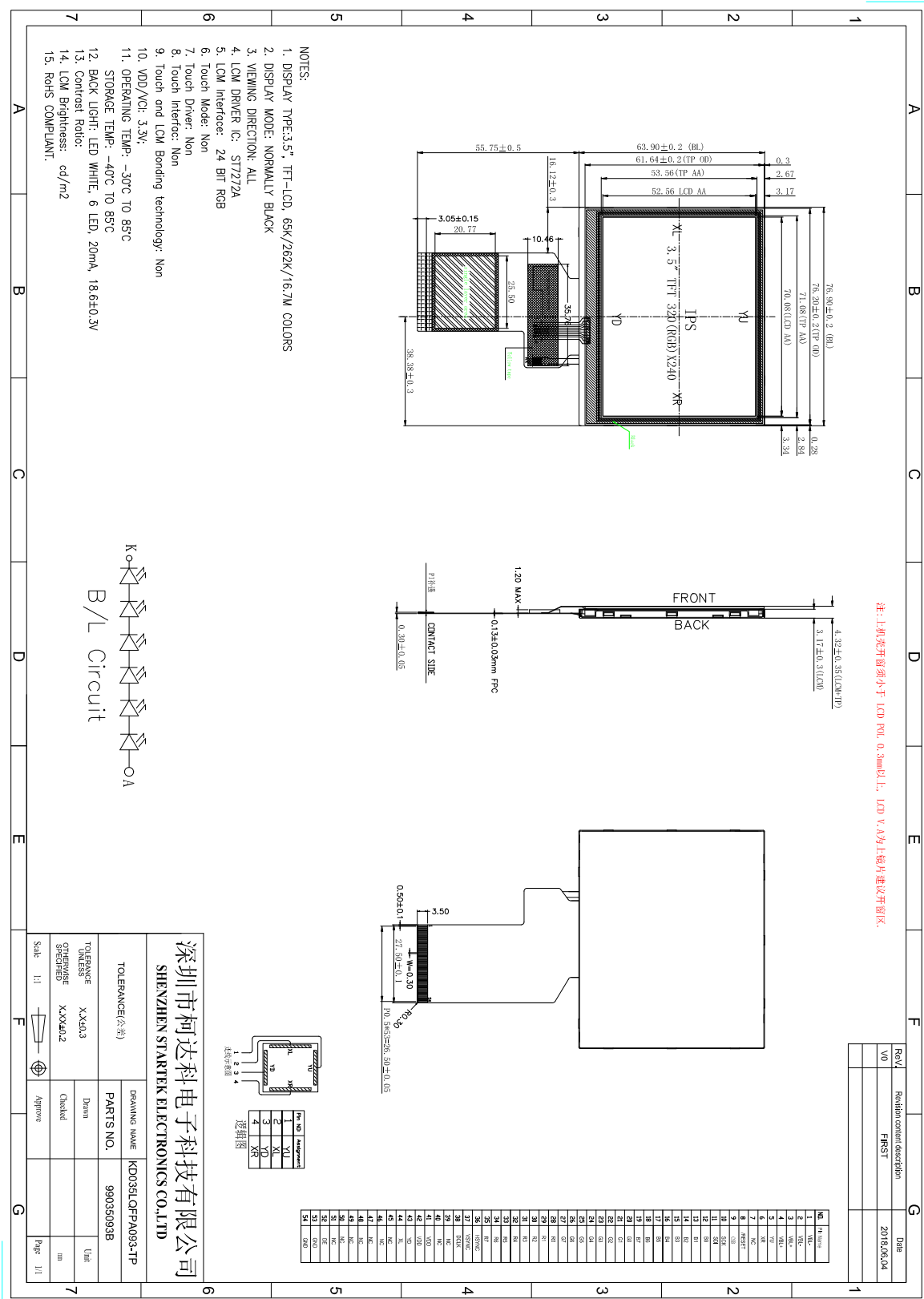


1. Block Diagram



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2. Outline dimension



3. Input terminal Pin Assignment

NO.	SYMBOL	DISCRIPTION	I/O
1	VBL-	Cathode pin of backlight.	P
2	VBL-	Cathode pin of backlight.	P
3	VBL+	Anode pin of backlight.	P
4	VBL+	Anode pin of backlight.	P
5	YU(NC)	Touch panel Top Film Terminal	A/D
6	XR(NC)	Touch panel Right Glass Terminal	A/D
7	NC	--	
8	/RESET	Global reset pin. When GRB is “L” , internal initialization procedure is executed.	I
9	CSB	Serial communication chip selection.	Open
10	SCK	Serial communication clock input.	Open
11	SDI	Serial communication data input and output.	Open
12-19	B0-B7	8 bit data bus display blue data. B[7:0] are not used in 8-bit RGB interface and should be connected to “L” .	I
20-27	G0-G7	8 bit data bus display green data. DG[7:0] are used in 8-bit RGB interface.	I
28-35	R0-R7	8 bit data bus display red data. DR[7:0] are not used in 8-bit RGB interface and should be connected to “L” .	I
36	HSYNC	Horizontal sync signal, default is negative polarity.	I
37	VSYN	Vertical sync signal, default is negative polarity.	I
38	DCLK	Pixel clock input pin	I
39	NC	--	
40	NC	--	
41	VDD	Supply voltage(3.3V).	P
42	VDD	Supply voltage(3.3V).	P
43	YD(NC)	Touch panel Bottom Film Terminal	A/D
44	XL(NC)	Touch panel LEFT Glass Terminal	A/D
45	NC	--	



46	NC	--	
47	NC	--	
48	NC	--	
49	NC	--	
50	NC	--	
51	NC	--	
52	DE	Data input enable. Display access is enabled when DE is "H" .	I
53	GND	Ground.	P
54	GND	Ground.	P

4. LCD Optical Characteristics

4.1 Optical specification

Item		Symbol	Condition	Min.	Typ.	Max.	Unit.	Note
Contrast Ratio		CR	$\Theta=0$ Normal viewing angle	640	800	--		(1)(2)
Response time	Rising	T_R+T_F		--	30	40	msec	(1)(3)
	Falling							
Uniformity		S(%)		55	60	--	%	C-light
Color Filter Chromaticity	White	W_X		0.293	0.333	0.373		(1)(4) CF glass C-light
		W_Y		0.333	0.373	0.413		
	Red	R_X		0.581	0.621	0.661		
		R_Y		0.315	0.355	0.395		
	Green	G_X		0.318	0.358	0.398		
		G_Y		0.562	0.602	0.642		
	Blue	B_X		0.110	0.150	0.190		
		B_Y		0.047	0.087	0.127		
Viewing angle	Hor.	Θ_L	CR>10	70	80	--		(1)(4)
		Θ_R		70	80	--		
	Ver.	Θ_U		70	80	--		
		Θ_D		70	80	--		
Option View Direction		Free						

4.2 Measuring Condition

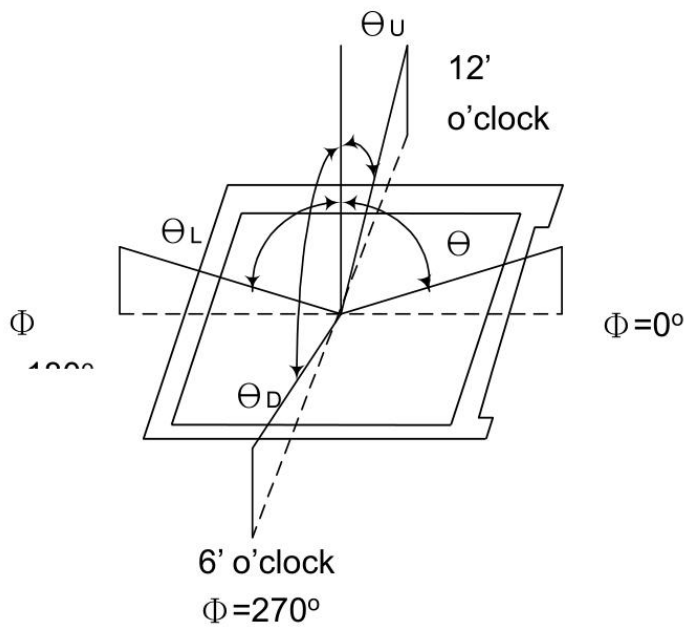
- Measuring surrounding: dark room
- Ambient temperature: $25 \pm 2^\circ\text{C}$
- 15min. warm-up time.

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4.3 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:

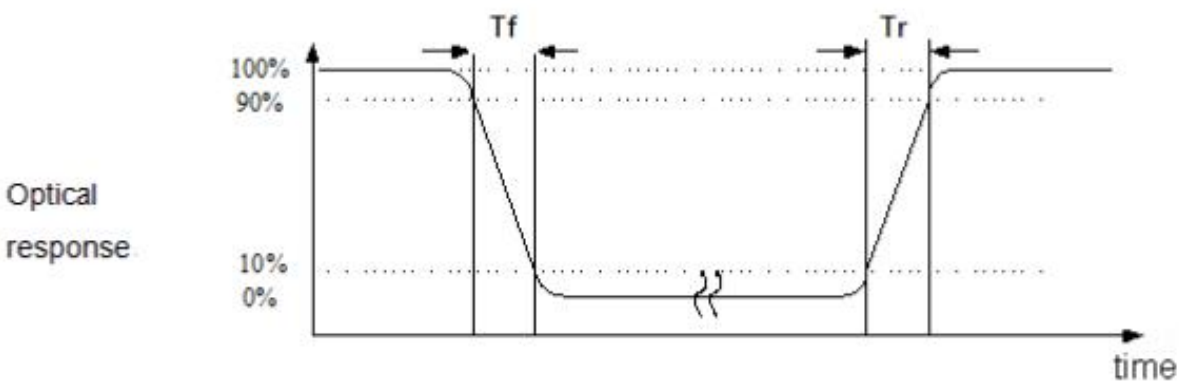


Note (2) Definition of Contrast Ratio (CR) :
measured at the center point of panel

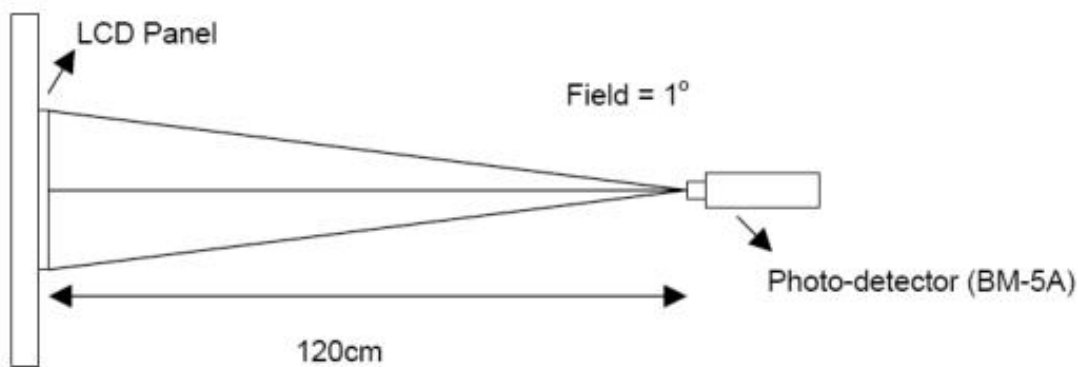
$$CR = \frac{\text{Luminance with all pixels white}}{\text{Luminance with all pixels black}}$$

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Note (3) Definition of Response Time : Sum of T_R and T_F



Note (4) Definition of optical measurement setup



5. Electrical Characteristics

5.1 Absolute Maximum Rating

Characteristics	Symbol	Min.	Max.	Unit	Note
Digital Supply Voltage	VDD	-0.3	4.0	V	Note1
Operating temperature	T _{OP}	-30	+85	°C	
Storage temperature	T _{ST}	-40	+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.

5.2 DC Electrical Characteristics

Characteristics	Symbol	Min.	Typ.	Max.	Unit	Note
Digital Supply Voltage	VDD	3.0	3.3	3.6	V	
Normal mode Current	IDD	--	20	--	mA	
Level input voltage	V _{IH}	0.7VDD	--	VDD	V	
	V _{IL}	GND	--	0.3 VDD	V	
Level output voltage	V _{OH}	VDD-0.4	--	VDD	V	
	V _{OL}	GND	--	GND+0.4	V	

5.3 LED Backlight Characteristics

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

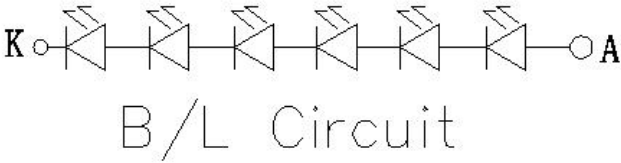
Item	Symbol	Min.	Typ.	Max.	Unit	Note
Forward Current	I _F	15	20	--	mA	
Forward Voltage	V _F	--	18.6	--	V	
LCM Luminance (I _F =20mA)	LV	400	450	--	cd/m2	Note3
LED life time	Hr	--	50000	--	Hour	Note1,2
Uniformity	Avg	80	--	--	%	Note3

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

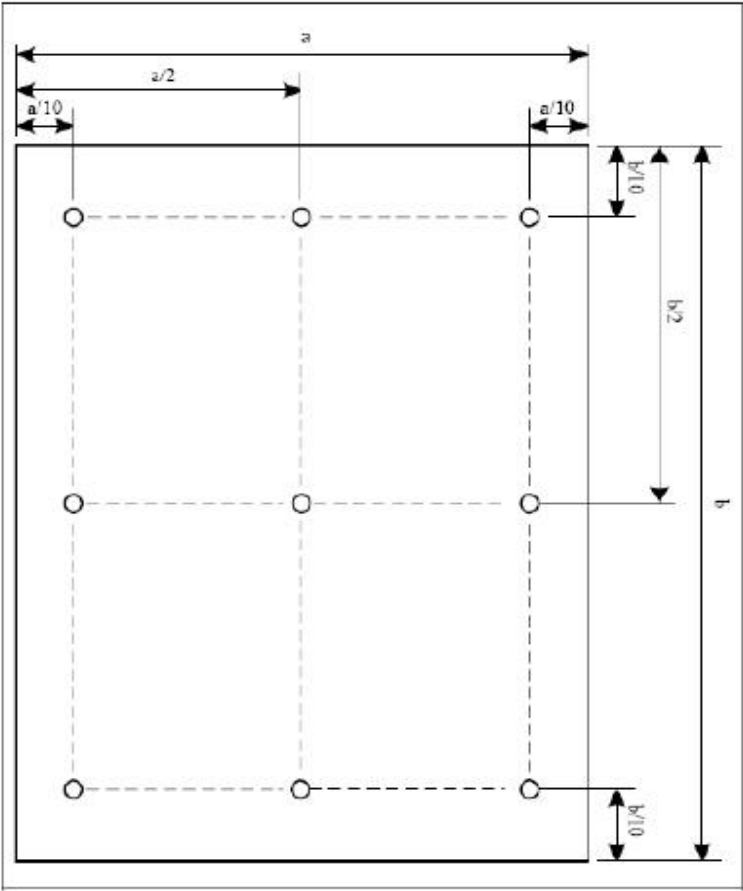
Ta=25±3 °C, typical IL value indicated in the above table until the brightness becomes less than 50%.

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

Ta=25℃ and IL=20 mA. 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:



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

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

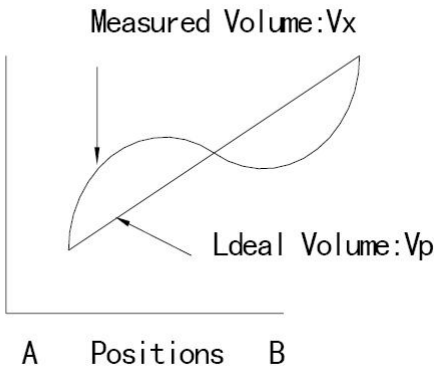
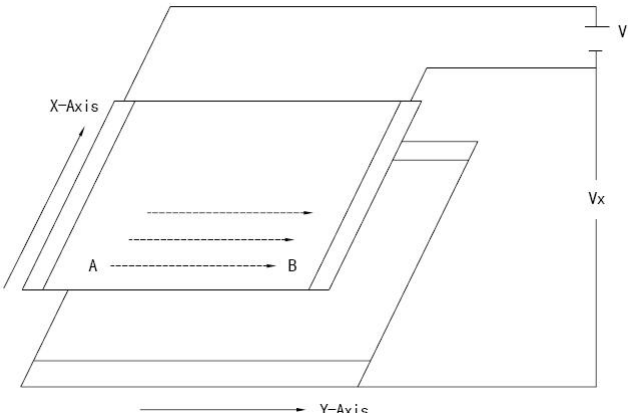
6. TP Feature

6.1 Conditions of use and storage

Item	Value(condition)	Note
Temperature range upon operation	Humidity: 20%~90% non dew, condensation -20℃~70℃	In a simple substance
Temperature range upon storage	Humidity: 20%~90% non dew, condensation -30℃~80℃	In a simple substance

6.2 Electrical property

Item	Value	Note
Maximum voltage	DC5V	
Resistance between terminals	X direction[Film side]:200-600Ω	
	Y direction [Glass side]:300-900Ω	
Insulation resistance	DC 25V 20MΩor above	Connect X + ~X- and Y+ ~Y-, apply 25VDC Between X and Y for perform measurements
Chattering	10 msec or below	
Rating	Voltage is DC 5V	



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6.3 Mechanical property

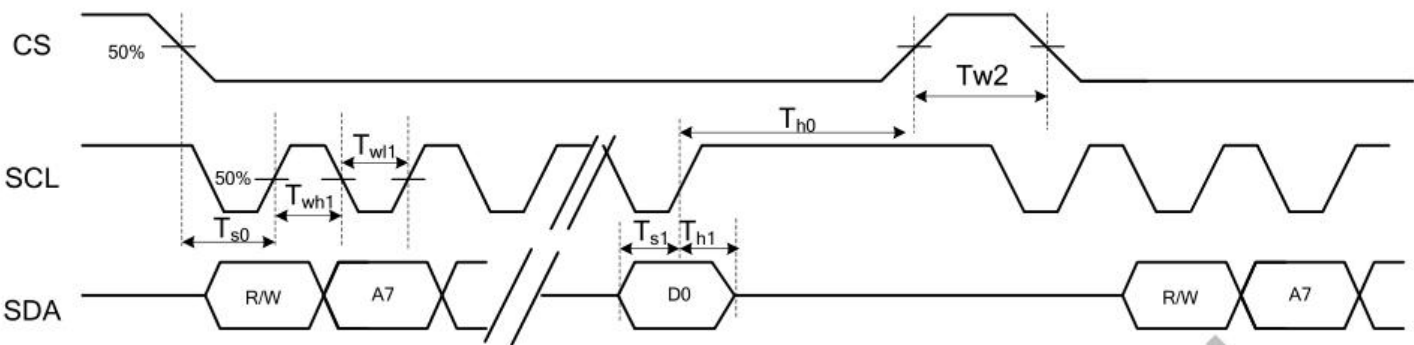
Item	Performance		Note
Input method	Used of an exclusive pen or finger		
Load upon operation	Exclusive pen	60-100g or below	Operation and measurement with a pen must be carried out under the following tip conditions: Stylus pen material : POM(ployacetal) . Tip : Diameter 3.0mm, SR 0.8 mm
	Finger	60-100g or below	Operations and measurement methods simulated for a finger must be carried out under the following tip conditions. Material :Silicon rubber (Hardness : 30°Hs) Tip : Diameter 12.0 mm, SR 12.5mm
Surface hardness	Pencil hardness : 3H or above		It complies with the way of test method JIS K5400.

6.4 Optical property

Item	Performance	Note
Total light transmittance	80% or above	JIS K7105
Haze	5% or below	JIS K7136
Film specification	Polished type with hard coated surface	

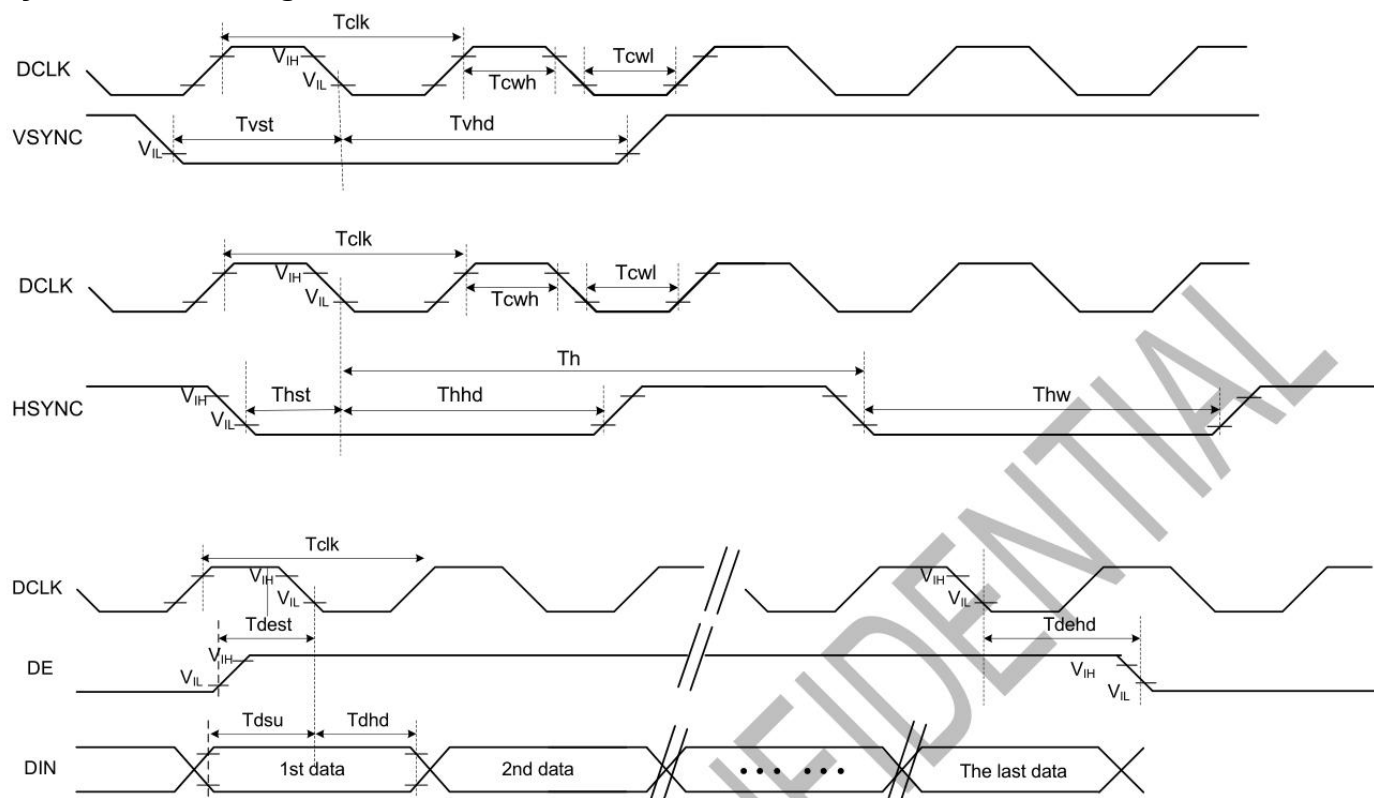
7. AC Characteristics

7.1 System Bus Timing for 3-Wire SPI Interface



Item	Symbol	Min.	Typ.	Max.	Unit	Conditions
CS Input Setup Time	Ts0	50	-	-	ns	
Serial Data Input Setup Time	Ts1	50	-	-	ns	
CS Input Hold Time	Th0	50	-	-	ns	
Serial Data Input Hold Time	Th1	50	-	-	ns	
SCL Write Pulse High Width	Twh1	50	-	-	ns	
SCL Write Pulse Low Width	Twl1	50	-	-	ns	
SCL Read Pulse High Width	Trh1	300			ns	
SCL Read Pulse Low Width	Trl1	300			ns	
CS Pulse High Width	Tw2	400	-	-	ns	

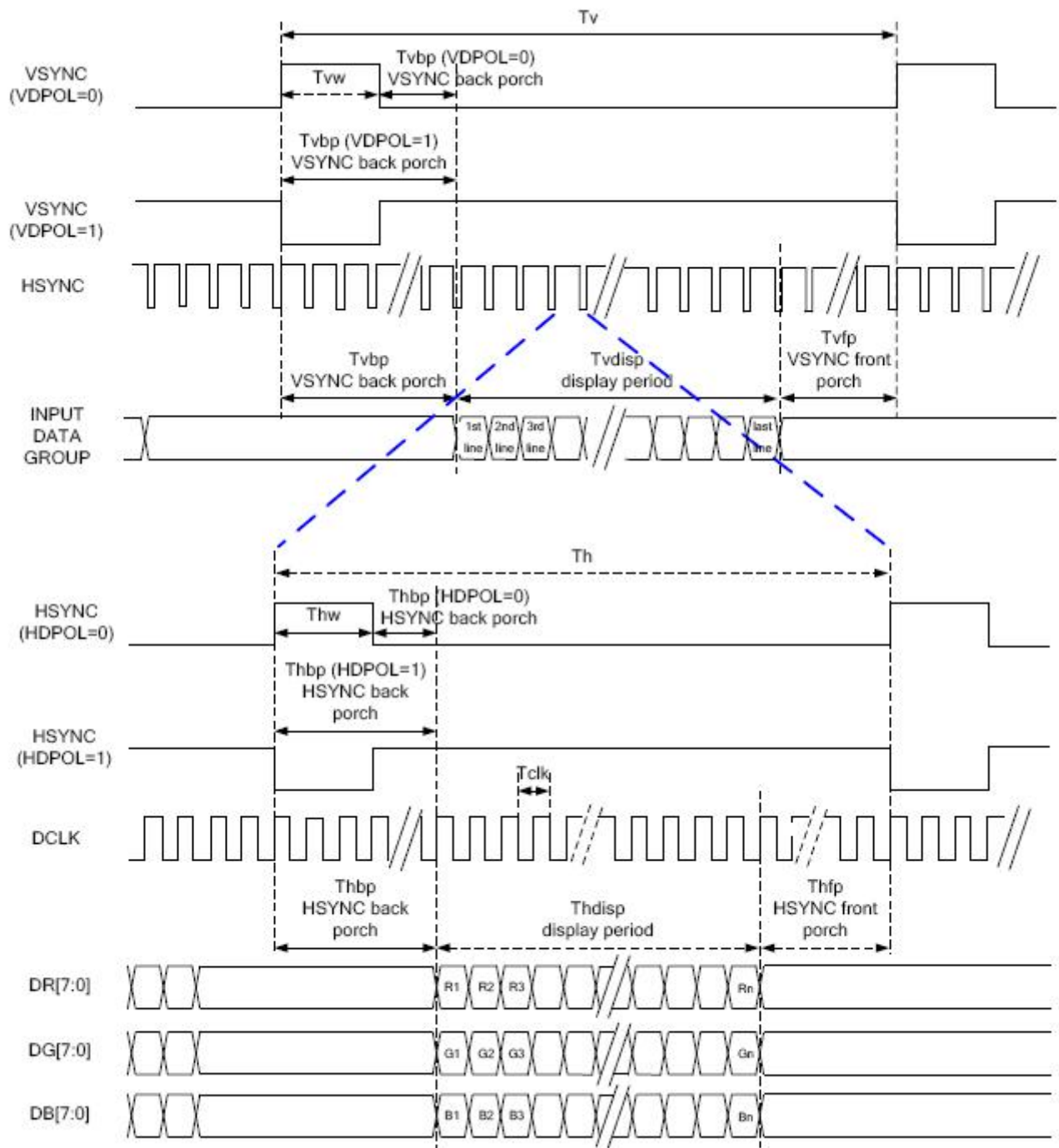
7.2 System Bus Timing for RGB Interface



Item	Symbol	Min.	Typ.	Max.	Unit	Conditions
CLK Pulse Duty	Tclk	40	50	60	%	
HSYNC Width	Thw	2	-	-	DCLK	
HSYNC Period	Th	55	60	65	us	
VSYNC Setup Time	Tvst	12	-	-	ns	
VSYNC Hold Time	Tvhd	12	-	-	ns	
HSYNC Setup Time	Thst	12	-	-	ns	
HSYNC Hold Time	Thhd	12	-	-	ns	
Data Setup Time	Tdsu	12	-	-	ns	
Data Hold Time	Tdhd	12	-	-	ns	
DE Setup Time	Tdest	12	-	-	ns	
DE Hold Time	Tdehd	12	-	-	ns	

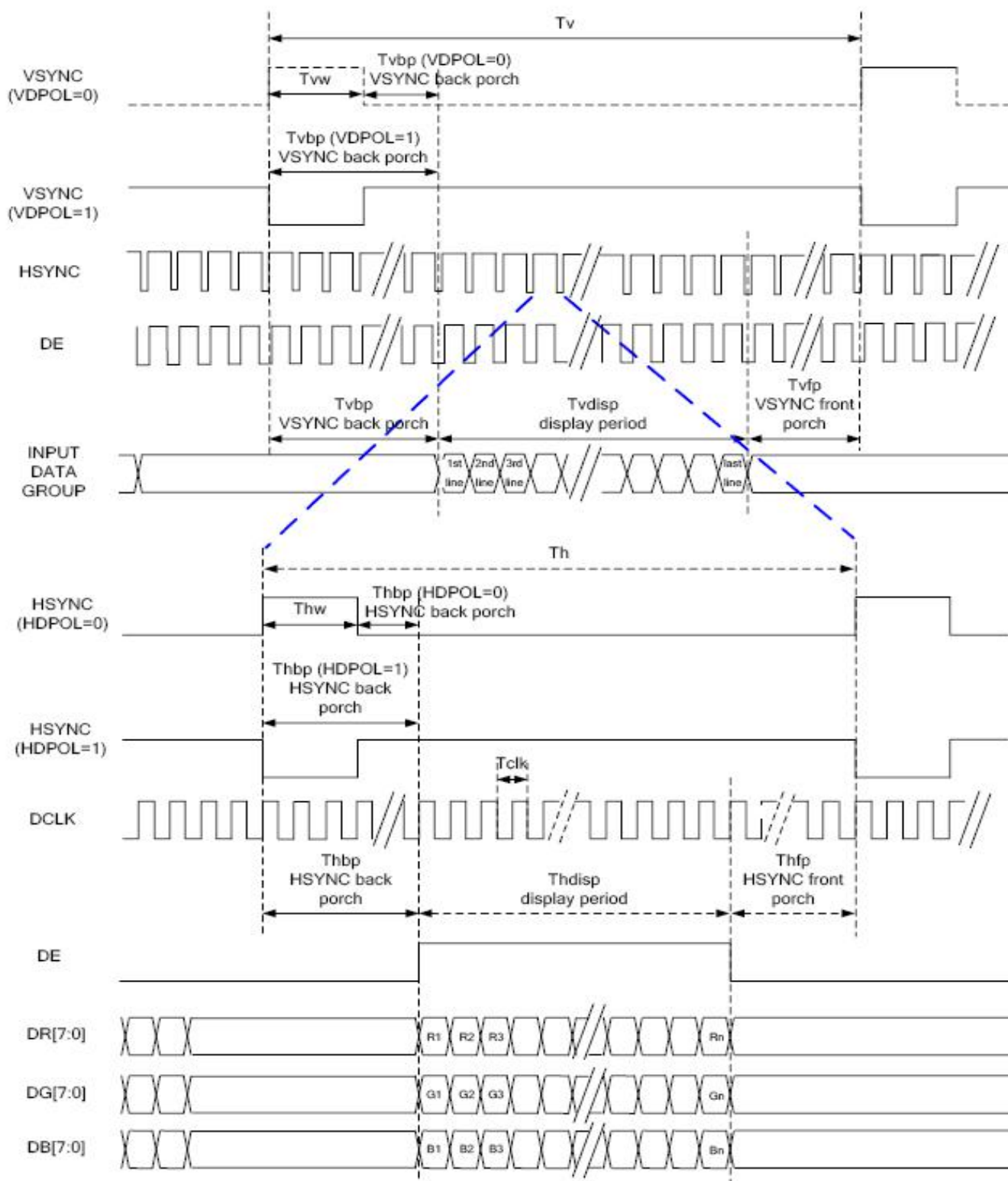
7.3 RGB Interface

7.3.1 SYNC Mode



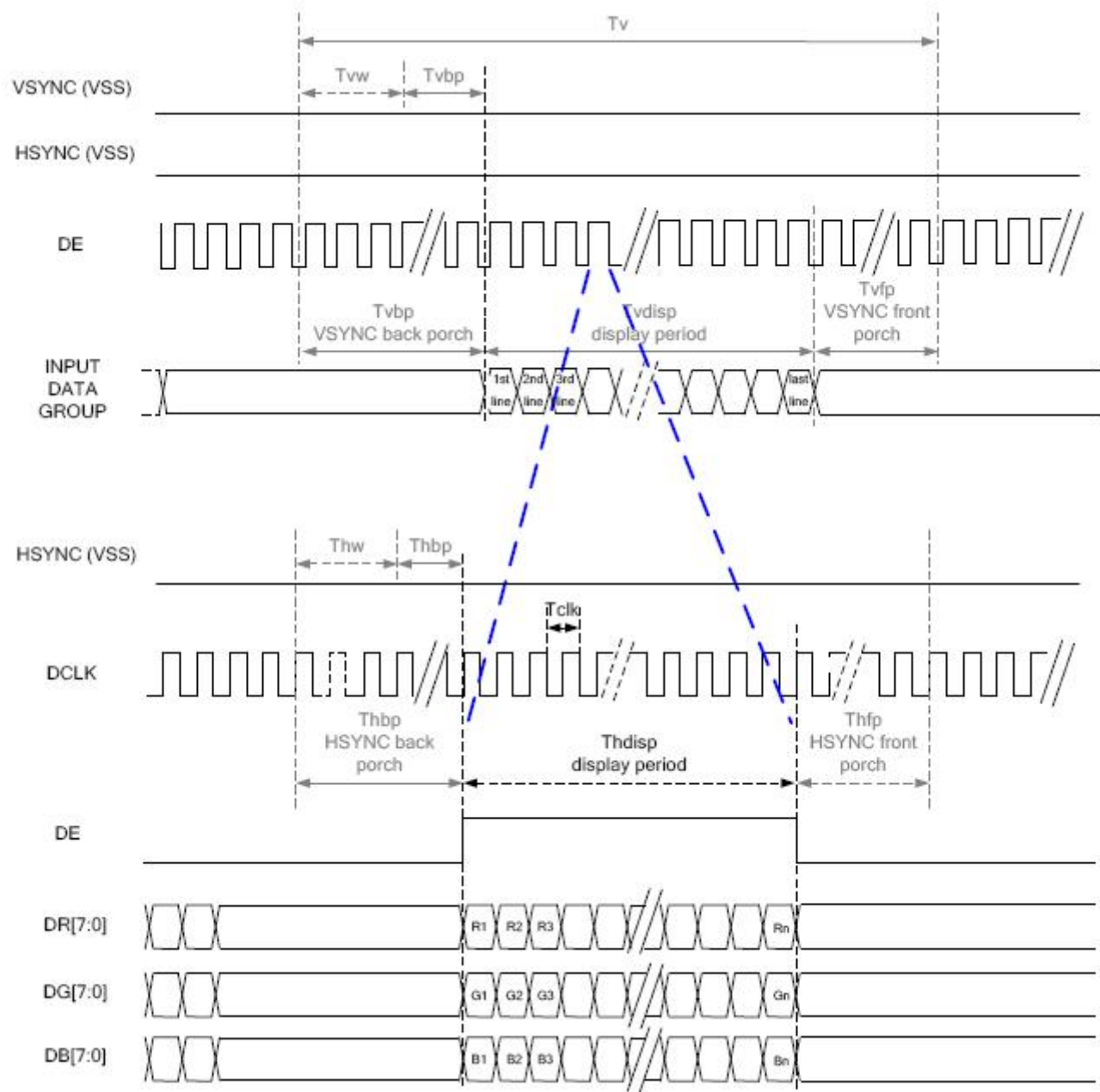


7.3.2 SYNC-DE Mode



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7.3.3 DE Mode



RGB Mode Selection Table	DCLK	HSYNC	VSYNC	DE
SYNC - DE Mode	Input	Input	Input	Input
SYNC Mode	Input	Input	Input	GND
DE Mode	Input	GND	GND	Input

Note: "Input" means these signals are driven by host side.

7.3.4 Parallel 24-bit RGB Input Timing Table

Parallel 24-bit RGB Input Timing (PVDD=VDD=VDDI= 3.3V, AGND= 0V, TA=25°C)

Parallel 24-bit RGB Input Timing Table							
Item		Symbol	Min.	Typ.	Max.	Unit	Remark
DCLK Frequency		Fclk	5	6	8	MHz	
DCLK Period		Tclk	125	167	200	ns	
HSYNC	Period Time	Th	325	371	438	DCLK	
	Display Period	Thdisp		320		DCLK	
	Back Porch	Thbp	3	43	43	DCLK	By H_BLANKING setting
	Front Porch	Thfp	2	8	75	DCLK	
	Pulse Width	Thw	2	4	43	DCLK	
VSYNC	Period Time	Tv	244	260	289	HSYNC	
	Display Period	Tvdisp		240		HSYNC	
	Back Porch	Tvbp	2	12	12	HSYNC	By V_BLANKING setting
	Front Porch	Tvfp	2	8	37	HSYNC	
	Pulse Width	Tvw	2	4	12	HSYNC	

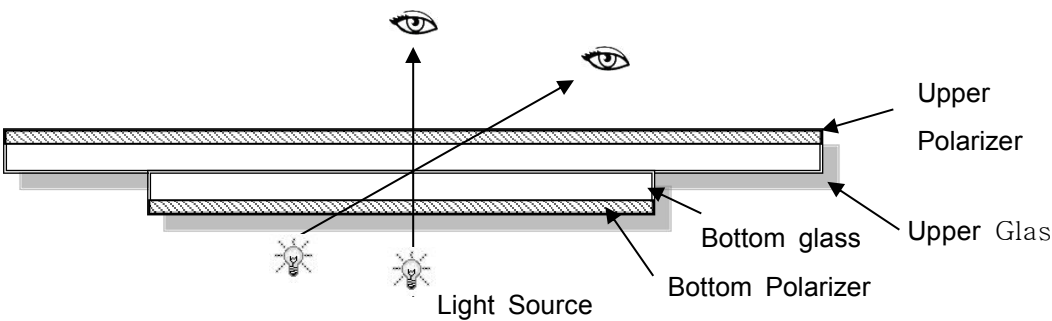
Note: It is necessary to keep Tvbp =12 and Thbp =43 in sync mode. DE mode is unnecessary to keep it.

8. LCD Module Out-Going Quality Level

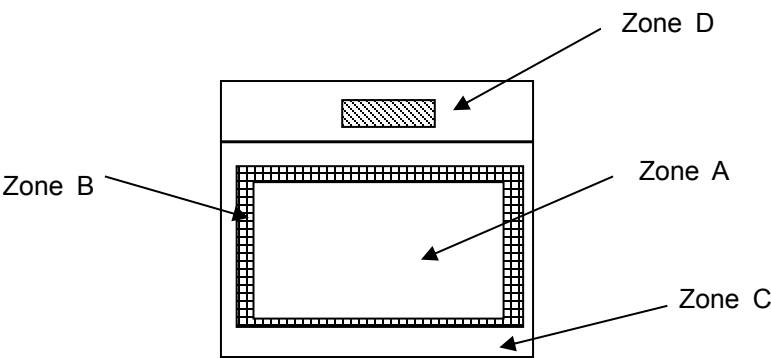
8.1 VISUAL & FUNCTION INSPECTION STANDARD

8.1.1 Inspection conditions

- Inspection performed under the following conditions is recommended.
- Temperature : 25±5℃
- Humidity : 65%±10%RH
- Viewing Angle : Normal viewing Angle.
- Illumination: Single fluorescent lamp (300 to 700Lux)
- Viewing distance:30-50cm



8.1.2 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

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8.1.3 Sampling Plan

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

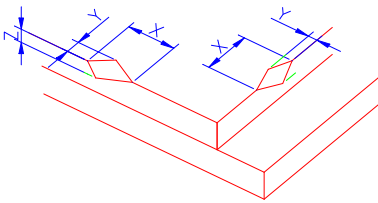
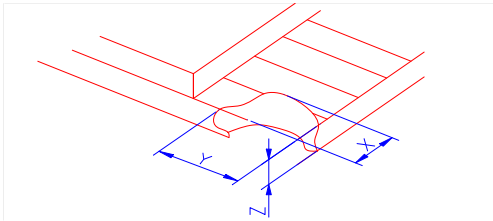
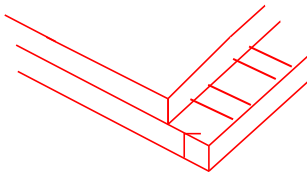
AQL:

Major defect	Minor defect
0.65	1.5

LCD: Liquid Crystal Display , TP: Touch Panel , LCM: Liquid Crystal Module

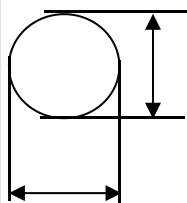
No	Items to be inspected	Criteria	Classification of defects
1	Functional defects	1) No display, Open or miss line 2) Display abnormally, Short 3) Backlight no lighting, abnormal lighting. 4) TP no function	Major
2	Missing	Missing component	
3	Outline dimension	Overall outline dimension beyond the drawing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

8.1.4 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							

2.0

Spot defect



Y

X

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

① light dot (LCD/TP/Polarizer black/white spot , light dot, pinhole, dent, stain)

Zone Size (mm)	Acceptable Qty		
	A	B	C
$\Phi \leq 0.10$	Ignore		Ignore
$0.10 < \Phi \leq 0.25$	3(distance $\geq 10\text{mm}$)		
$0.25 < \Phi \leq 0.3$	2		
$\Phi > 0.35$	0		

② Dim spot (LCD/TP/Polarizer dim dot, light leakage, dark spot)

Zone Size (mm)	Acceptable Qty		
	A	B	C
$\Phi \leq 0.1$	Ignore		Ignore
$0.10 < \Phi \leq 0.25$	3(distance $\geq 10\text{mm}$)		
$0.25 < \Phi \leq 0.3$	2		
$\Phi > 0.35$	0		

③ Polarizer accidented spot

Zone Size (mm)	Acceptable Qty		
	A	B	C
$\Phi \leq 0.2$	Ignore		Ignore
$0.3 < \Phi \leq 0.5$	2(distance $\geq 10\text{mm}$)		
$\Phi > 0.5$	0		

④ Pixel bad points (light dot, Dim dot, color dot)

Zone Size (mm)	Acceptable Qty		
	A	B	C
$\Phi \leq 0.1$	Ignore	Ignore	
$0.15 < \Phi \leq 0.25$	2(distance $\geq 10\text{mm}$)		
$\Phi > 0.3$	0		

⑤ Polarizer Bubble

Zone Size (mm)	Acceptable Qty		
	A	B	C
$\Phi \leq 0.2$	Ignore		Ignore
$0.3 < \Phi \leq 0.4$	3(distance $\geq 10\text{mm}$)		
$0.4 < \Phi \leq 0.5$	2		
$\Phi > 0.5$	0		

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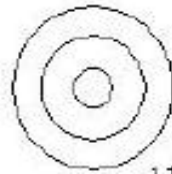
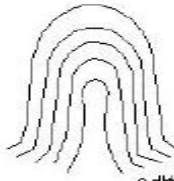
长期供货
Long Time supply

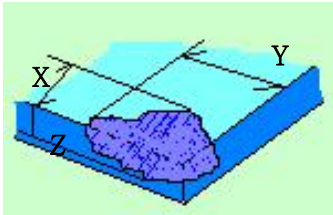
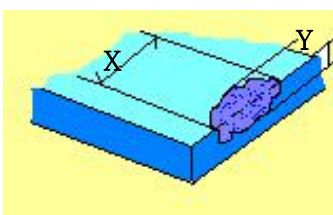
支持小量
NO MOQ

品种齐全
In Full Range

3.0	Line defect (LCD/TP /Polarizer backlight black/white line, scratch, stain)	Width(mm)	Length(m)	Acceptable Qty		
				A	B	C
		$\Phi \leq 0.05$	Ignore	Ignore		Ignore
		$0.05 < W \leq 0.06$	$L \leq 3.0$	$N \leq 2$		
		$0.07 < W \leq 0.08$	$L \leq 2.0$	$N \leq 1$		
		$0.08 < W$	Define as spot defect			
4.0	Electronic Components SMT	Not allow missing parts, solderless connection, cold solder joint, mismatch, The positive and negative polarity opposite				
5.0	Display color& Brightness	1. Color: Measuring the color coordinates, The measurement standard according to the datasheet or samples. 2. Brightness: Measuring the brightness of White screen, The measurement standard according to the datasheet or Samples.				
6.0	LCD Mura	By 5% ND filter invisible.				

7.0	RTP Related	TP film bubble/accidental spot				
			Size Φ (mm)	Acceptable Qty		
				A	B	C
			$\Phi \leq 0.1$	Ignore		Ignore
			$0.1 < \Phi \leq 0.2$	3 (distance ≥ 10 mm)		
			$0.25 < \Phi \leq 0.3$	2		
$\Phi > 0.35$	0					

TP film scratch	Width(mm)	Length (mm)	Acceptable Qty		
			A	B	C
	$\Phi \leq 0.05$	Ignore	Ignore		Ignore
	$0.05 < W \leq 0.06$	$L \leq 3.0$	$N \leq 2$		
	$0.07 < W \leq 0.08$	$L \leq 2.0$	$N \leq 1$		
$0.08 < W$	Define as spot defect				
Assembly deflection	beyond the edge of backlight $\leq 0.2\text{mm}$				
Bulge (undulation included)	The ITO film plumped below 0.40mm, it's ok. 				
Newton Ring	Newton Ring area $> 1/3$ TP area NG Newton Ring area $\leq 1/3$ TP area OK		 1 规律性  2 非规律性  似牛顿环		

		TP corner broken X : length Y : width Z : height	<table><tr><td>X</td><td>Y</td><td>Z</td></tr><tr><td>$X \leq 3\text{mm}$</td><td>$Y \leq 3\text{mm}$</td><td>$Z < \text{COVER thickness}$</td></tr></table> * *Circuitry broken is not allowed.	X	Y	Z	$X \leq 3\text{mm}$	$Y \leq 3\text{mm}$	$Z < \text{COVER thickness}$	
X	Y	Z								
$X \leq 3\text{mm}$	$Y \leq 3\text{mm}$	$Z < \text{COVER thickness}$								
		TP edge broken X : length Y : width Z : height	<table><tr><td>X</td><td>Y</td><td>Z</td></tr><tr><td>$X \leq 4\text{mm}$</td><td>$Y \leq 2\text{mm}$</td><td>$Z < \text{COVER thickness}$</td></tr></table> * Circuitry broken is not allowed.	X	Y	Z	$X \leq 4\text{mm}$	$Y \leq 2\text{mm}$	$Z < \text{COVER thickness}$	
X	Y	Z								
$X \leq 4\text{mm}$	$Y \leq 2\text{mm}$	$Z < \text{COVER thickness}$								

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	TP no function	Not allowed

8. 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	-40°C, 96HR	
High Temperature & High	+60°C, 90% RH ,96 hours.	
Thermal Shock (Non-operation)	-30°C,30 min ↔ +85°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,80 _{cm} (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.

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9. Cautions and Handling Precautions

9.1 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

9.2 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.

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10. Packing

-----TBD-----

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