倍顯(香港)有限公司
Facelcd(HongKong) Limited

DISPLAY CORPORATION

LCD MODULE

SPECIFICATION

Customer: _____

Model

Name: **FB035XHG304-A**

Date: **2016/04/18**

Version: **2.3** _____

☐**Preliminary Specification**

■**Final Specification**

For Customer's Acceptance

Approved by	Comment

Approved by	Reviewed by	Prepared by
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CONTENTS

RECORD OF REVISIONS

Revision	Date	Page	Description
1.0	2008/2/12	all	New Creation
1.1	2008/6/13	18	LCM PIN Definition
2.0	2009/08/13	all	Change format from 奇信 to CMI
2.1	2009/11/17	27	Change Outline drawing
		28	Change Package Information
2.2	2015/11/27	All	Change site from 棠裕 to 寧波
		21	Modify the max of Response time
		21	Change the Brightness min. from 200nits to 350nits；typ. from 300nits to 450nits.
		26	Add Notes3 of QUALITY ASSURANCE
2.3	2016/04/18	21	Change the Brightness min. from 350nits to 200nits；typ. from 450nits to 300nits.
		28	update outline drawing .
		30~31	Update package drawing.

1. SUMMARY

This technical specification applies to 3.45"color TFT-LCD panel. The 3.45" color TFT-LCD panel is designed for GPS, camcorder, digital camera application and other electronic products which require high quality flat panel displays.
This module follows RoHS.

2. FEATURES

High Resolution: 230,400 Dots (320RGB x 240). FB035XHG304-A is a transmissive type color active matrix liquid crystal display (LCD) which uses amorphous thin film transistor (TFT) as switching devices. This product is composed of a TFT LCD panel, driver ICs, FPC, backlight unit.

3. GENERAL SPECIFICATIONS

Parameter		Specifications	Unit
Screen size		3.45(Diagonal)	Inch
Display Format		320 RGB x 240	Dot
Active area		70.08(H) x 52.56(V)	mm
Dot size		73x 219	um
Pixel Configuration		RGB-Stripe	
Outline dimension		76.9(W) x 63.9(H) x 3.26(D)	mm
Display Mode		Normally white/Transmissive	
Surface Treatment		Haze 20%	
Display Garmut		NTSC 60%	
Input Interface		Digital 24-bit RGB/SERIAL RGB/CCIR656/CCIR601	
Weight		30	g
View Angle direction		6 o'clock	
Temperature Range	Operation	-20~70	℃
	Storage	-30~80	℃

4. ABSOLUTE MAXIMUM RATINGS

Item	Symbol	Condition	Min.	Max.	Unit	Remark
Power Voltage	DVDD,AVDD	GND=0	-0.3	5.0	V	
Input Signal Voltage	V_{in}	GND=0	-0.3	VDD+0.3	V	NOTE
Logic Output Voltage	V_{OUT}	GND=0	-0.3	VDD+0.3	V	NOTE

Note: Device is subject to be damaged permanently if stresses beyond those absolute maximum ratings listed above
1. Temp. ≤ 60℃, 90% RH MAX.
   Temp.> 60℃, Absolute humidity shall be less than 90% RH at 60℃
2.

Ambient Temp. vs. Allowable Forward Current
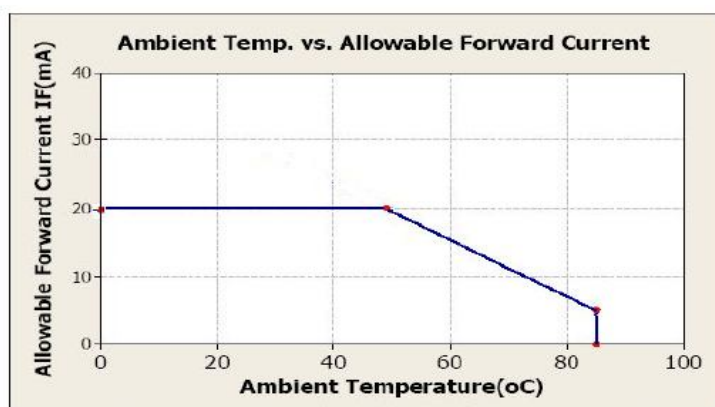
5. ELECTRICAL CHARACTERISTICS

5.1. Operating conditions:

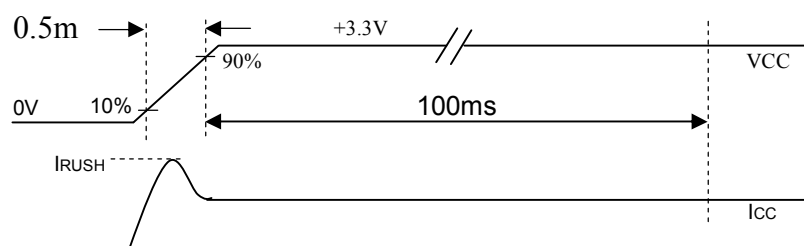| Parameter	Symbol	Rating			Unit	Condition
		Min.	Typ.	Max.		
Power Voltage	VCC	3.0	3.3	3.6	V	
Digital Operation Current	Icc	-	8.6	15	mA	
Inrush Current	I$_{RUSH}$	-	-	260	mA	Note2
Gate On Power	VGH	-	13.9	-	V	
Gate Off Power	VGL	-	-13.6	-	V	
Vcom High Voltage	VCOMH	-	3.9	-	V	Note1
Vcom low Voltage	VCOML	-	-1.2	-	V	Note1
Vcom level max	VCOMA	-	-	6	V	

Note1:VcomH& VcomL：Adjust the color with gamma data. Vp-p should be higher then 4V.(Option 5V).
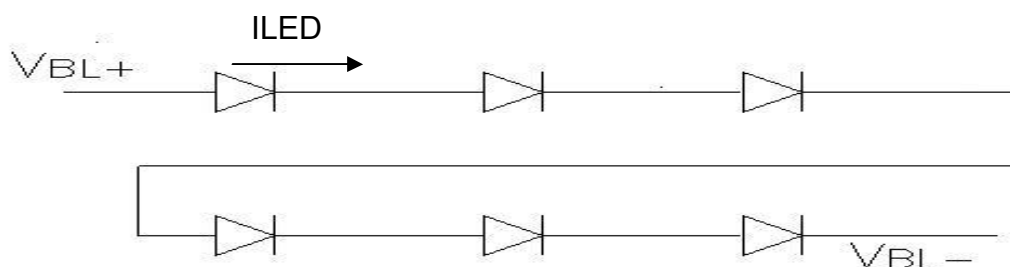Note2: I$_{RUSH}$: The maximum current when VCC is rising.
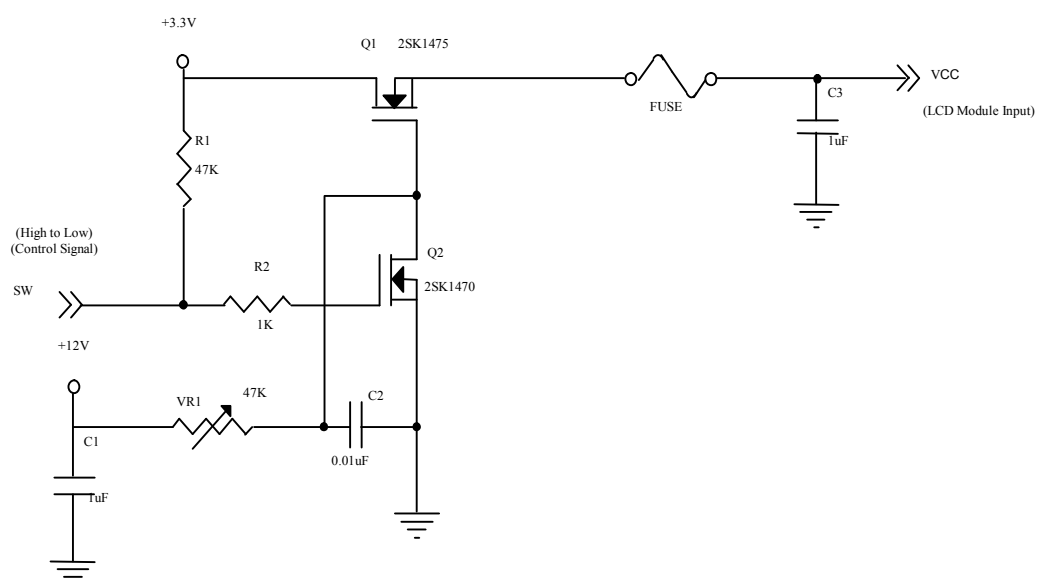
VCC rising time is 0.5ms

5.2 LED driving conditions

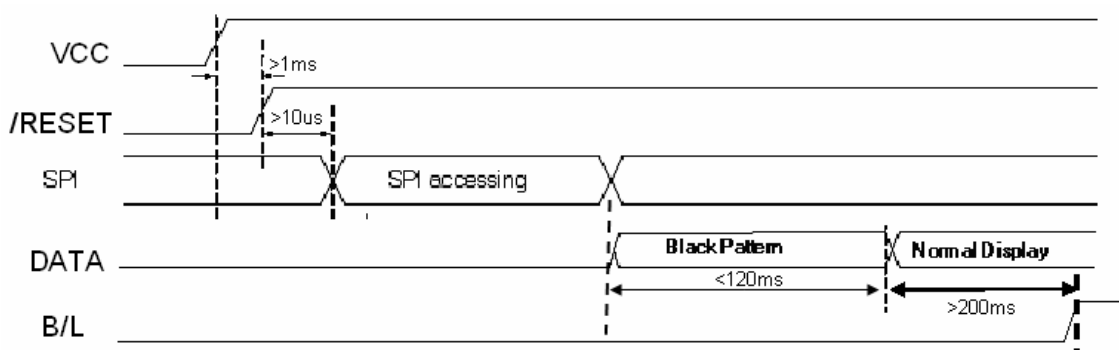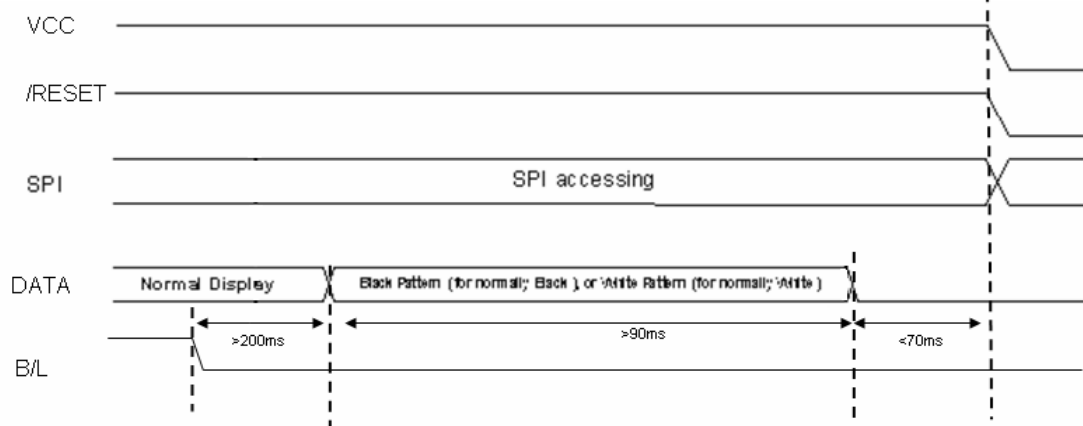| Parameter	Symbol	Min.	Typ.	Max.	Unit	Remark
LED current	I_{LED}	-	20	-	mA	
Power Consumption		-	400	420	mW	
LED voltage	VL	17.4	19.8	21	V	Note 1
LED Life Time	-	10,000	-	-	Hr	Note 2,3

Note 1 : There are 1 Groups LED

Note 2 : Ta = 25℃

Note 3 : Brightess to be decreased to 50% of the initial value

5.3 POWER ON/OFF SEQUENCE

power on sequence

power off sequence

6. DC CHARATERISTICS

Parameter	Symbol	Rating			Unit	Condition
		Min.	Typ.	Max.		
Low level input voltage	V_{IL}	0	-	0.3 VCC	V	
Hight level input voltage	V_{IH}	0.7 VCC	-	VCC	V	

7. AC CHARATERISTICS

Digital Parallal RGB interface

Signal	Item	Symbol	Min	Typ	Max	Unit
Dclk	Frequency	Tosc	-	156	-	ns
	High Time	Tch	-	78	-	ns
	Low Time	Tcl	-	78	-	ns
Data	Setup Time	Tsu	12	-	-	ns
	Hold Time	Thd	12	-	-	ns
Hsync	Period	TH	-	408	-	Tosc
	Pulse Width	THS	5	30	-	Tosc
	Back-Porch	Thb		38		Tosc
	Display Period	TEP	-	320	-	Tosc
	Hsync-den time	THE	36	68	88	Tsoc
	Front-Porch	Thf	-	20	-	Tosc
Vsync	Period	Tv	-	262	-	TH

Pulse Width	Tvs	1	3	5	TH
Back-Porch	Tvb	-	15	-	TH
Display Period	Tvd	-	240	-	TH
Front-Porch	Tvf	2	4	-	TH

Note: 1. Thp + Thb = 68, the user is make up by yourself.

2. Tv = Tvs + Tvb + Tvd + Tvf , the user is make up by yourself.

3. When SYNC mode is used, 1st data start from 68th Dclk after Hsync falling

Digital Serial RGB interface

Signal	Item	Symbol	Min	Typ	Max	Unit
Dclk	Frequency	Tosc	-	52	-	ns
	High Time	Tch	-	78	-	ns
	Low Time	Tcl	-	78	-	ns
Data	Setup Time	Tsu	12	-	-	ns
	Hold Time	Thd	12	-	-	ns
Hsync	Period	TH	-	1224	-	Tosc
	Pulse Width	THS	5	90	-	Tosc
	Back-Porch	Thb		114		Tosc
	Display Period	TEP	-	960	-	Tosc
	Hsync-den time	THE	108	204	264	
	Front-Porch	Thf	-	60	-	Tosc
Vsync	Period	Tv	-	262	-	TH
	Pulse Width	Tvs	1	3	5	TH
	Back-Porch	Tvb	-	15	-	TH
	Display Period	Tvd	-	240	-	TH
	Front-Porch	Tvf	2	4	-	TH

Note: 1. Thp + Thb = 204, the user is make up by yourself.
2. Tv = Tvs + Tvb + Tvd + Tvf , the user is make up by yourself.

3. When SYNC mode is used,1st data start from 204th Dclk after Hsync falling

CCIR601/656 Interface

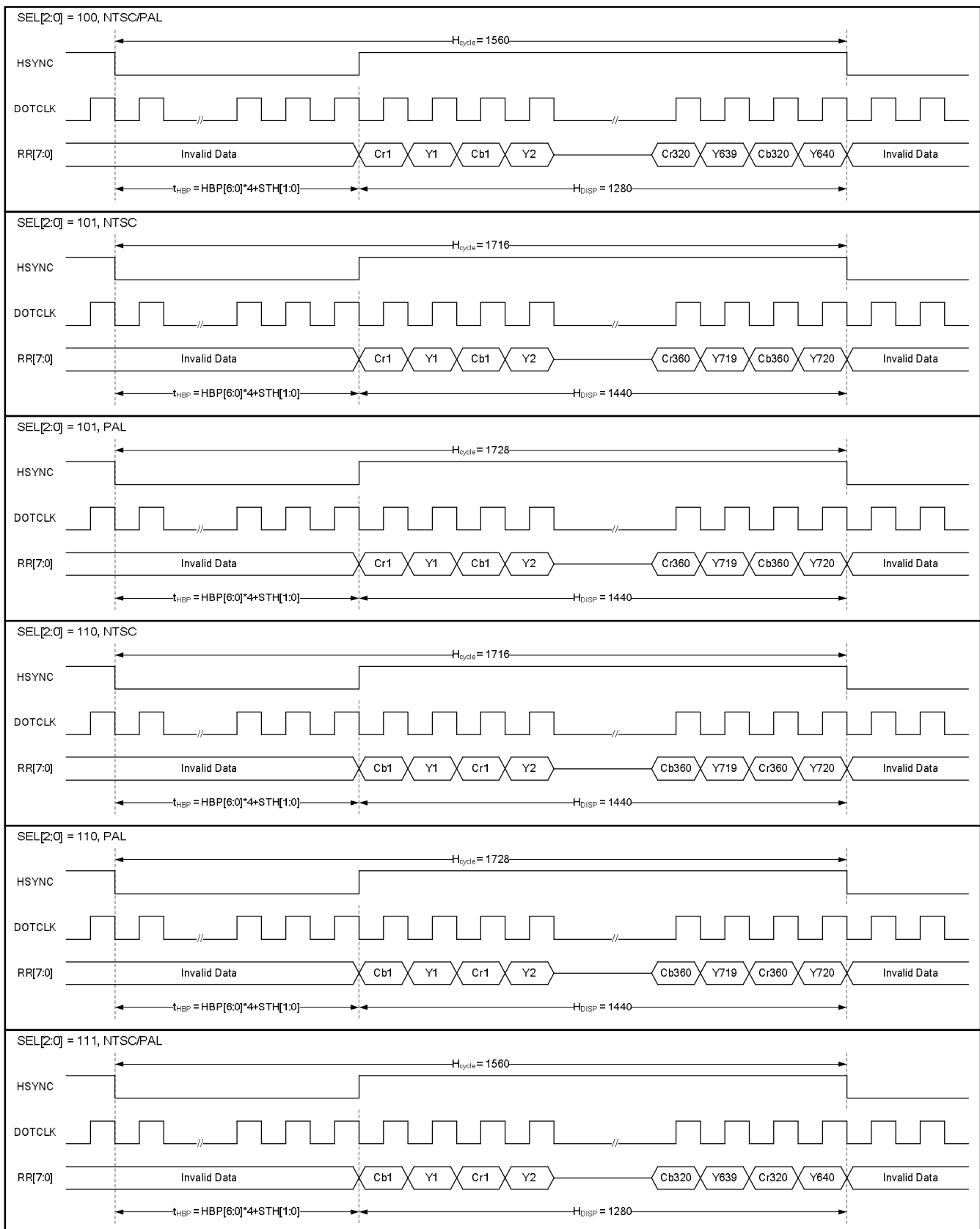| Signal	Item	Symbol	Min	Typ	Max	Unit
Dclk	Frequency	Tosc	-	37	-	ns
	High Time	Tch	-	78	-	ns
	Low Time	Tcl	-	78	-	ns
Data	Setup Time	Tsu	12	-	-	ns
	Hold Time	Thd	12	-	-	ns

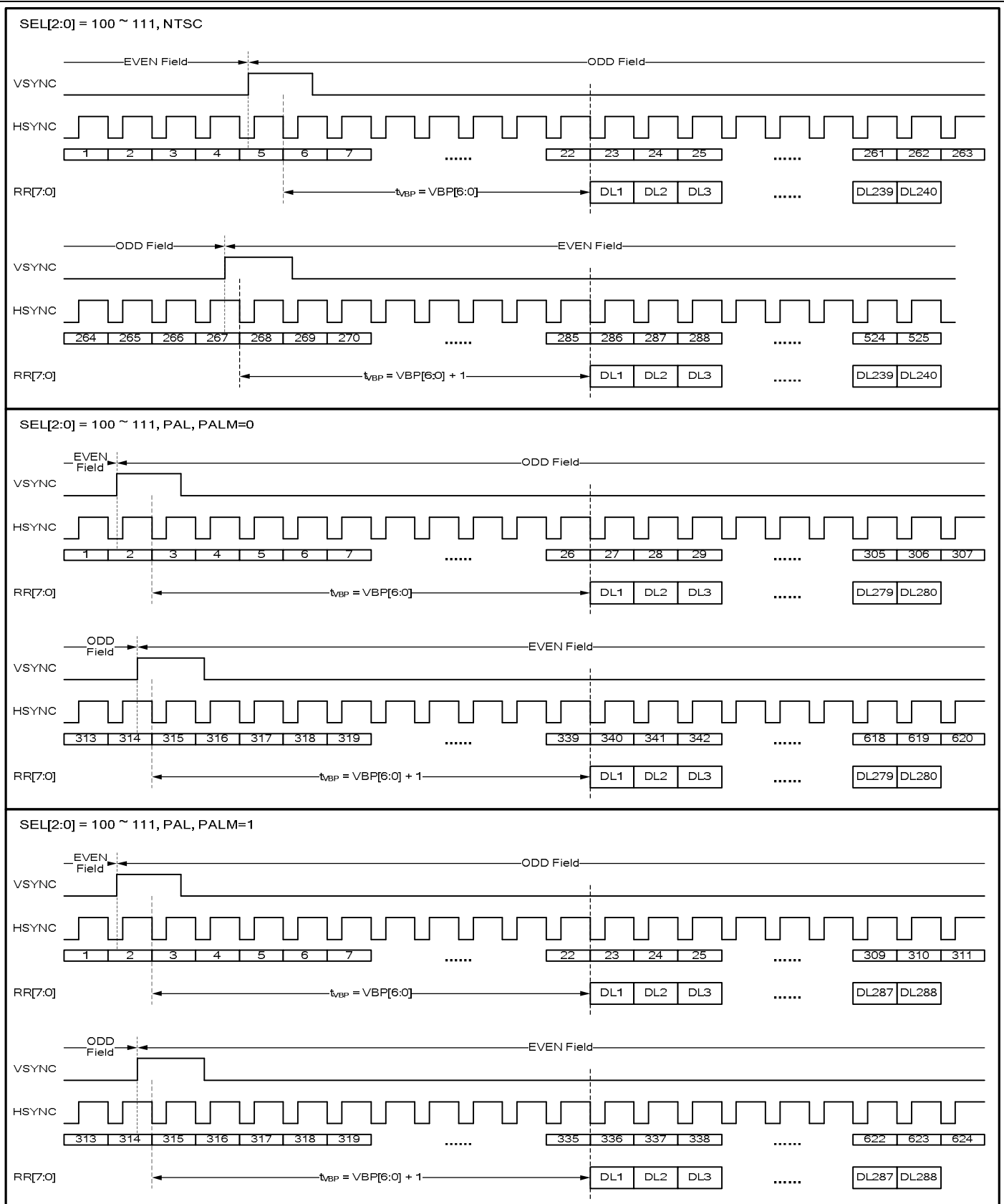**7.1 Waveform**

Figure 1　CCIR601 Horizontal Timing
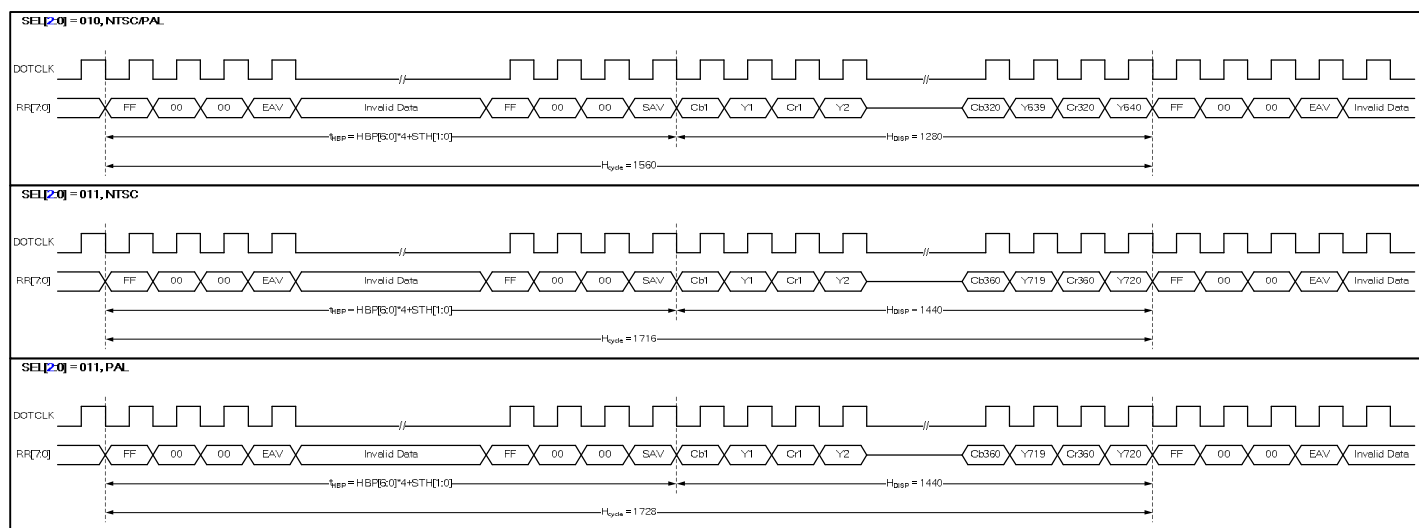
Figure 1　CCIR601 Vertical Timing

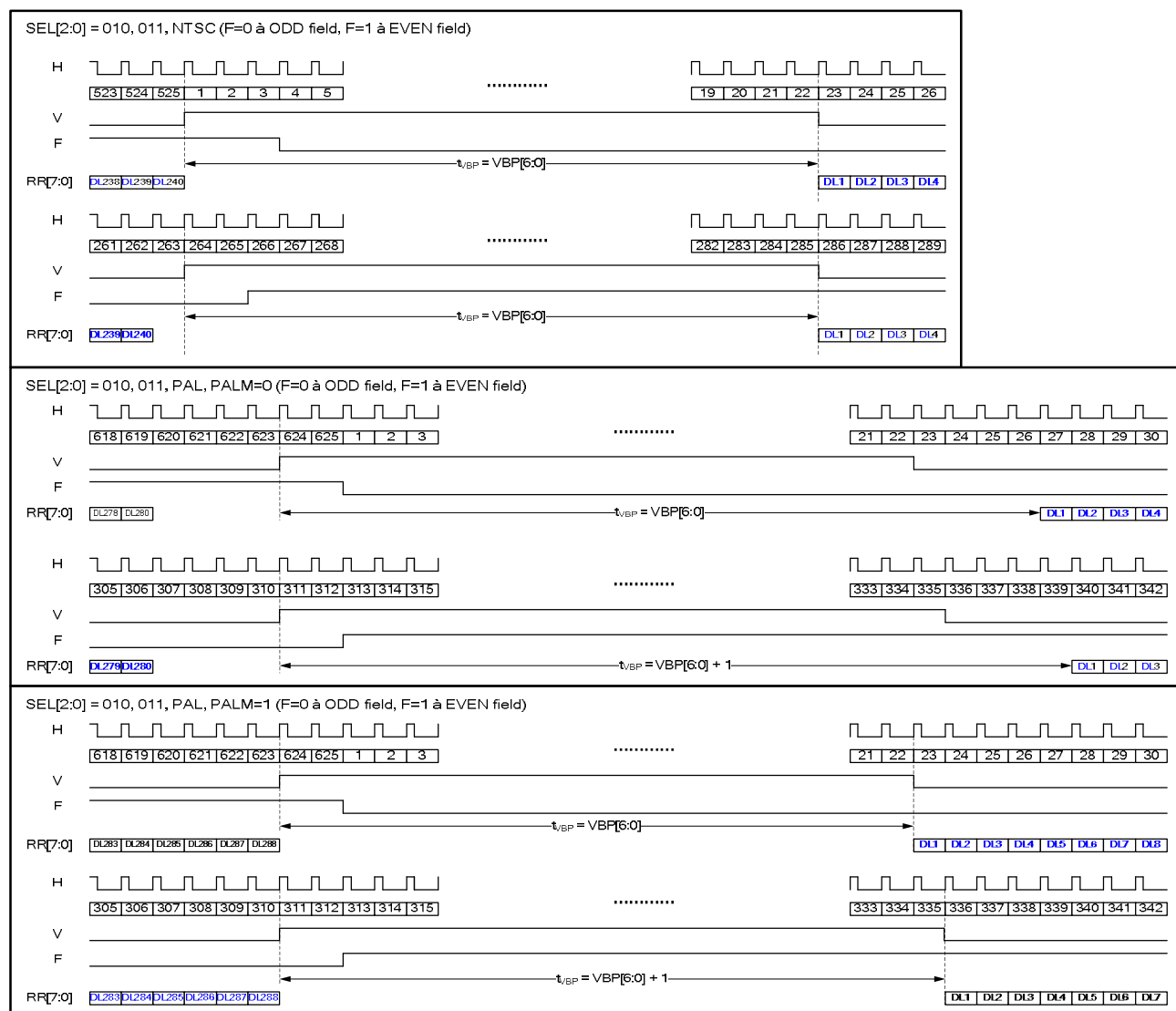**Figure 2 CCIR656 Horizontal Timing**
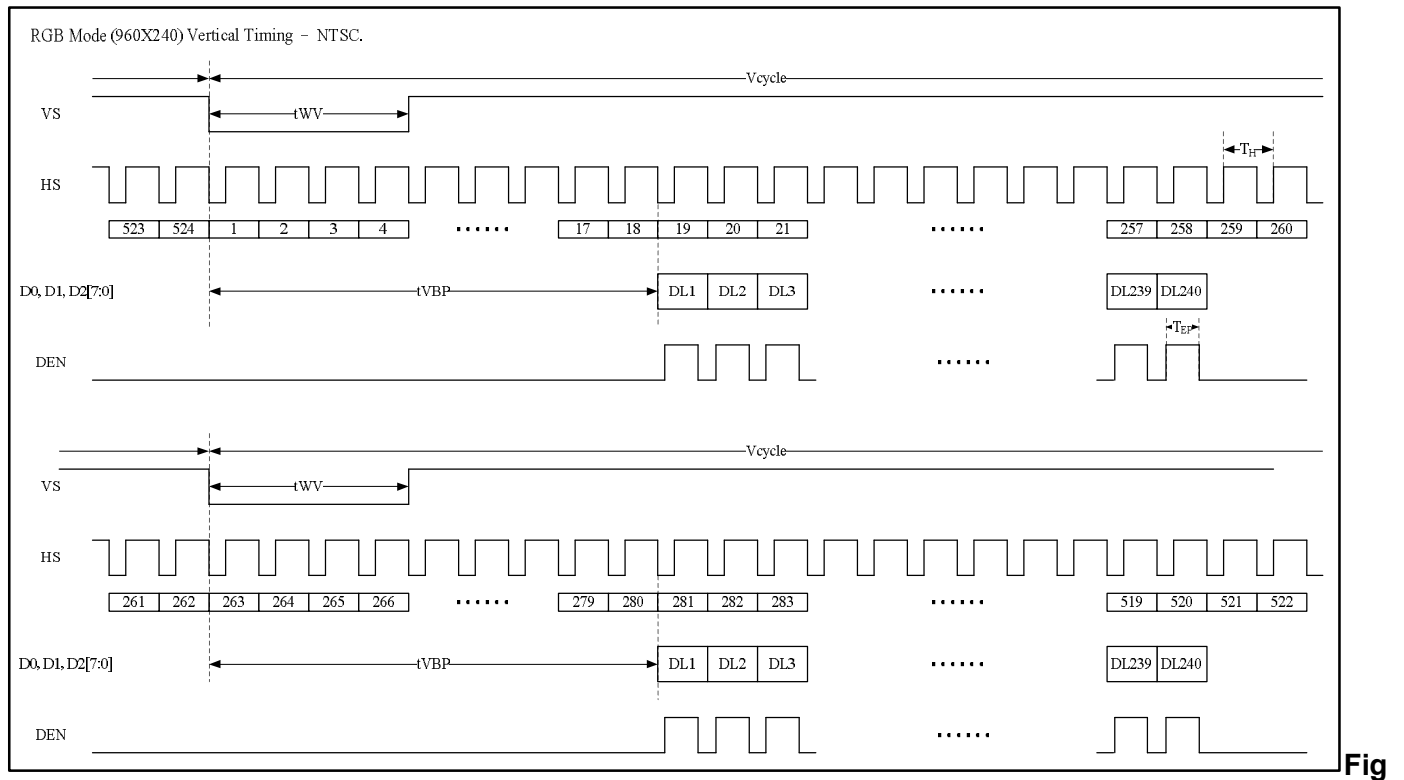

Figure 2 CCIR656 Vertical Timing

Figure 3 Digital RGB NTSC mode Vertical Data Format for 262T$_H$
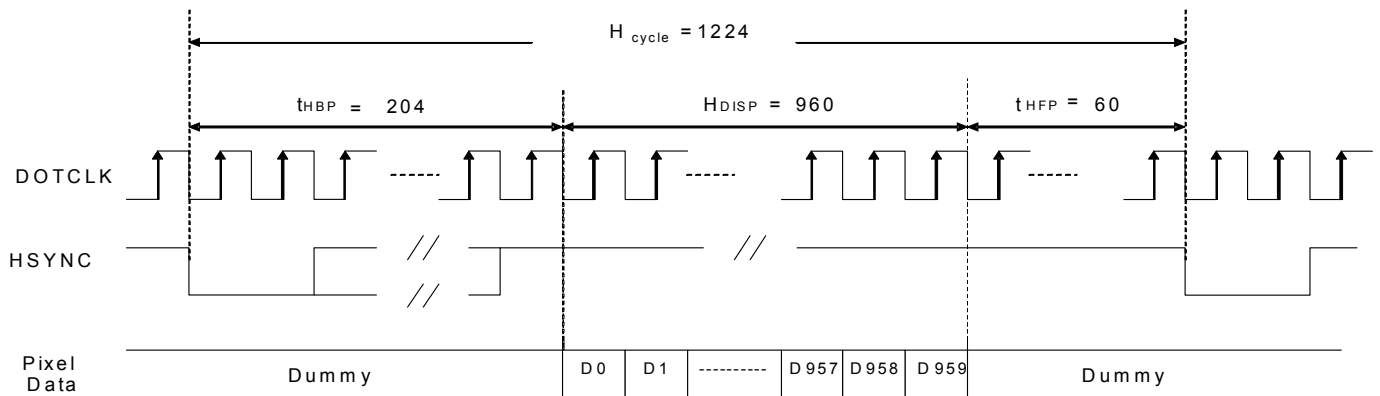
a) Horizontal Data Transaction Timing
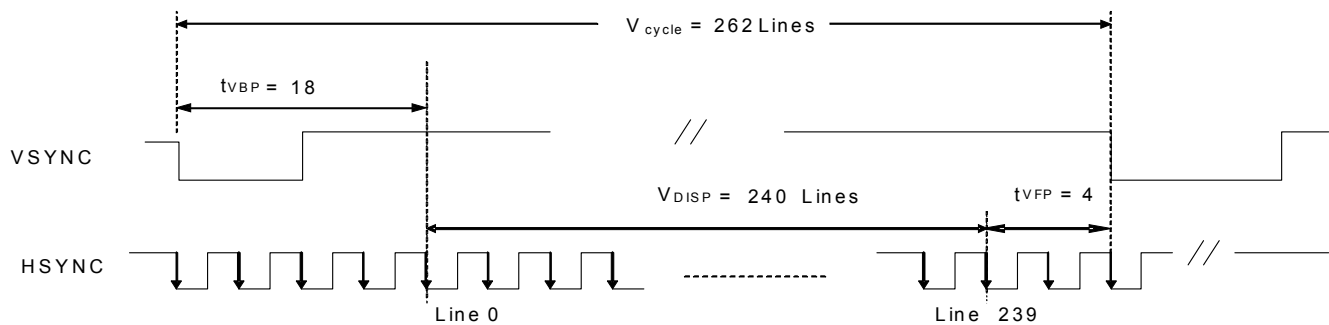
b) Vertical Data Transaction Timing

Figure 3 Data Transaction Timing in Serial RGB (8 bit) Interface (SYNC Mode)

Figure 3 Data Transaction Timing in Serial RGB (8 bit) Interface (DE Mode)

a) Horizontal Data Transaction Timing

b) Vertical Data Transaction Timing

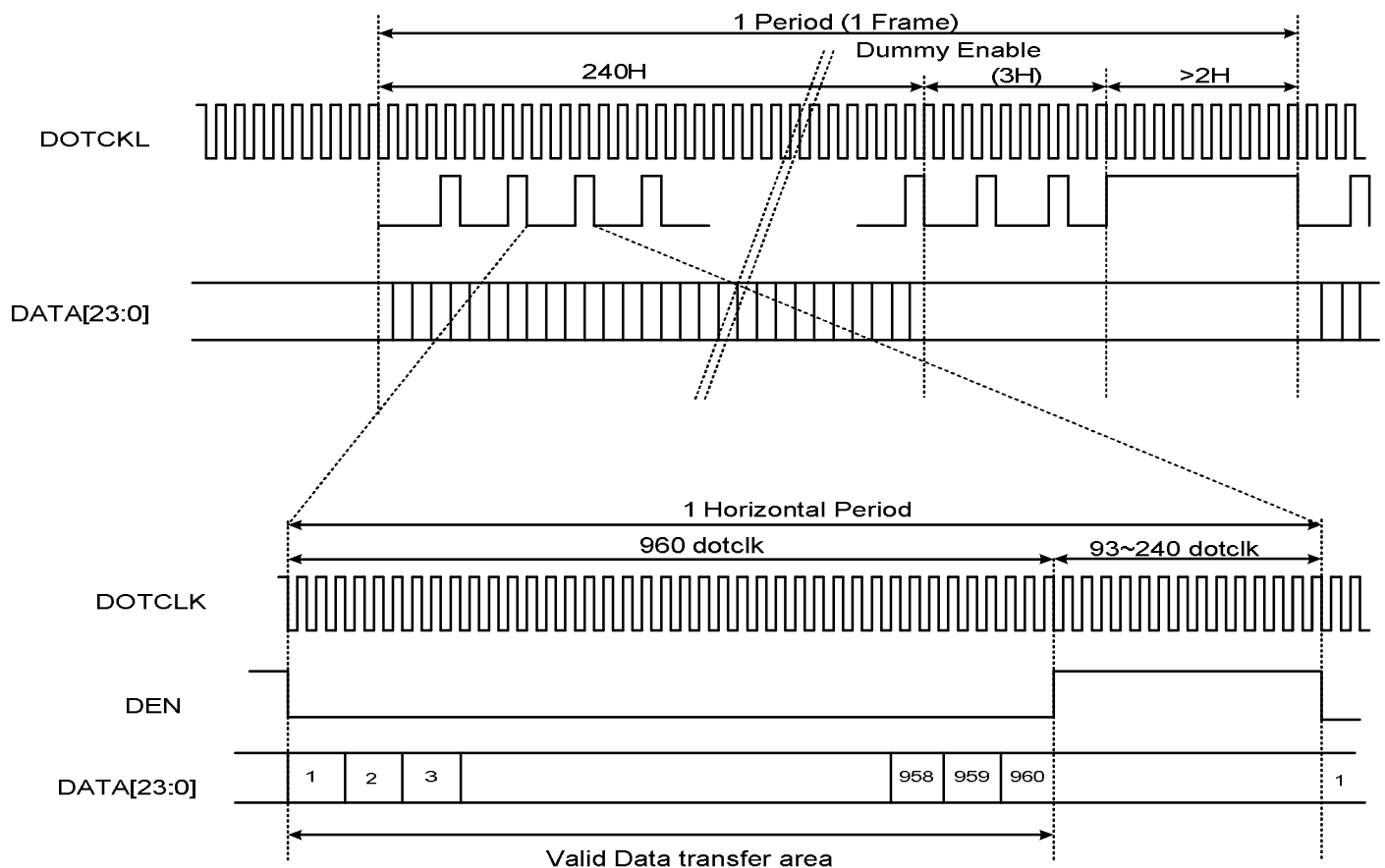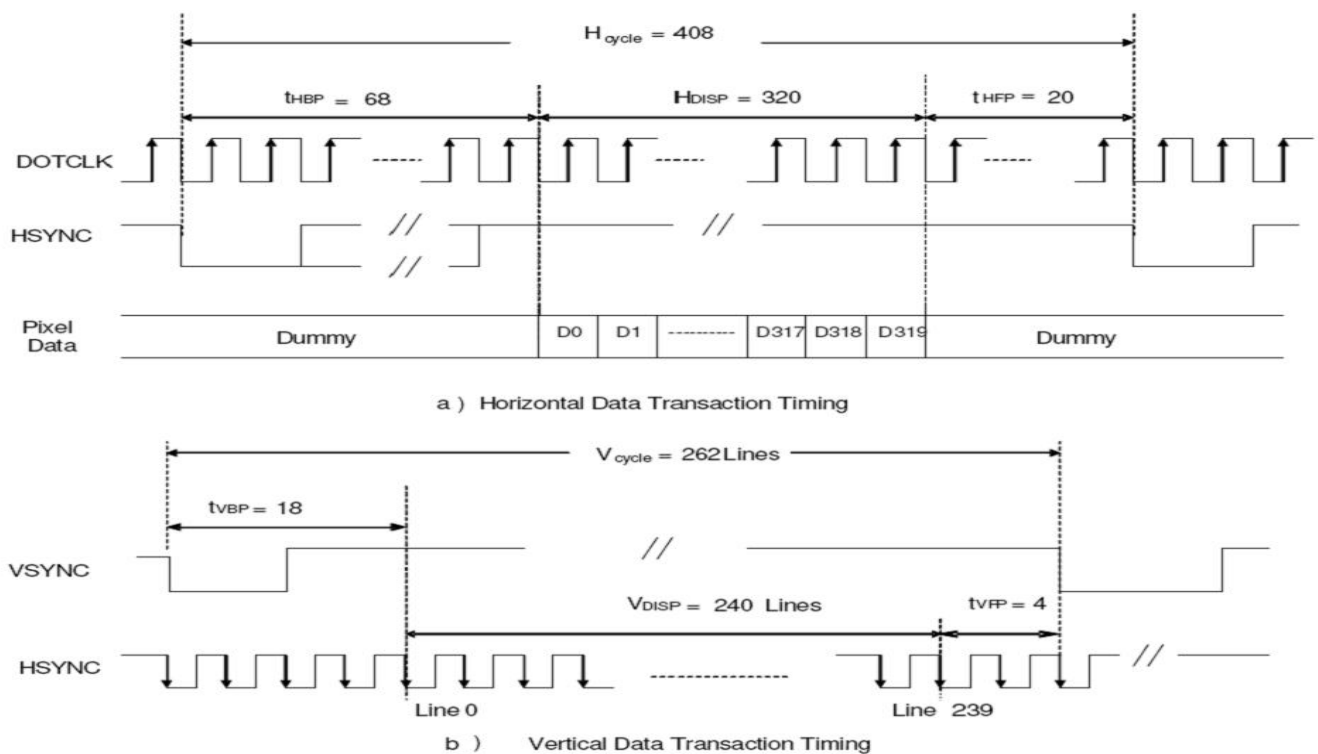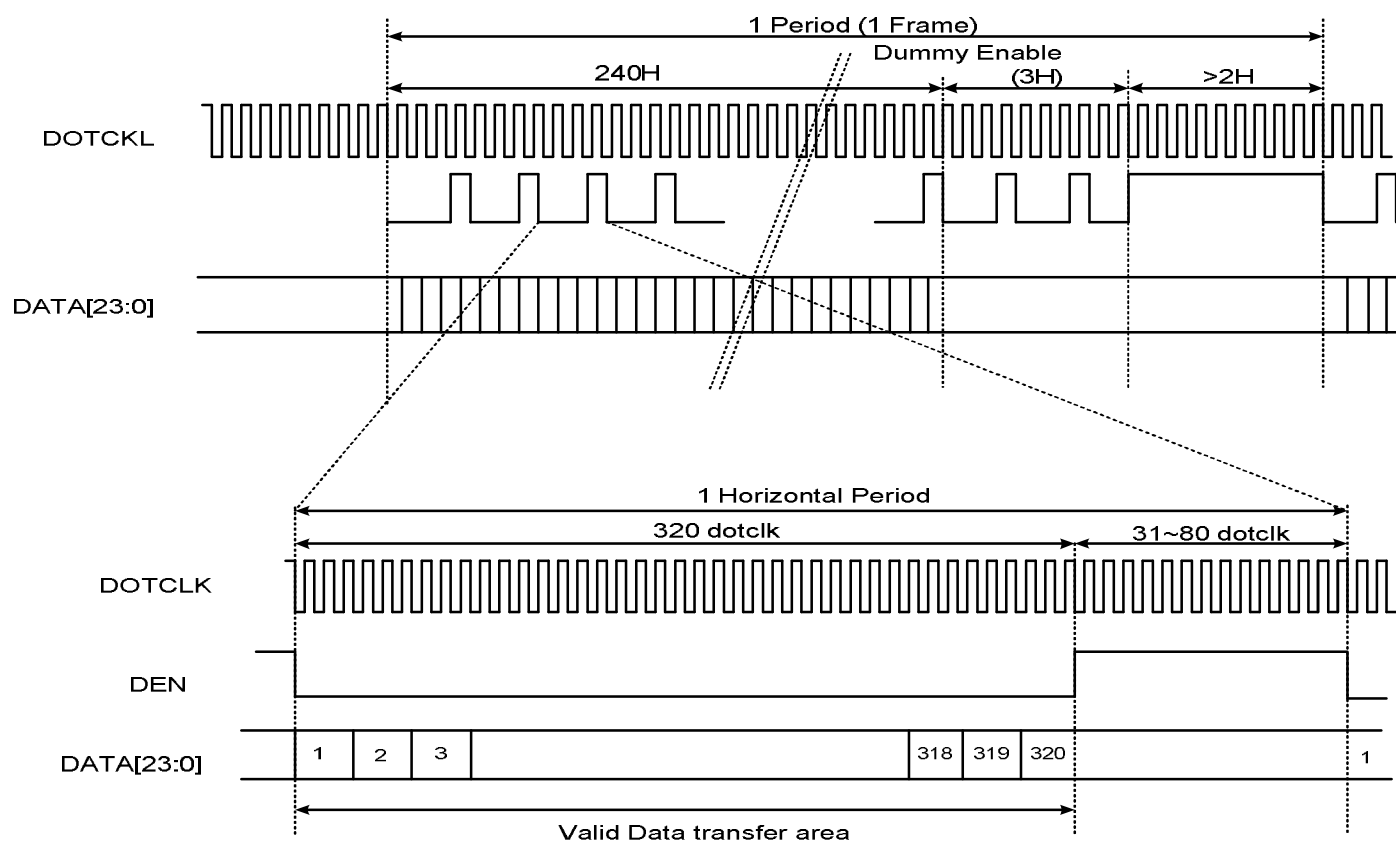**Figure 3 Data Transaction Timing in Parallel RGB (24 bit) Interface (SYNC Mode)**

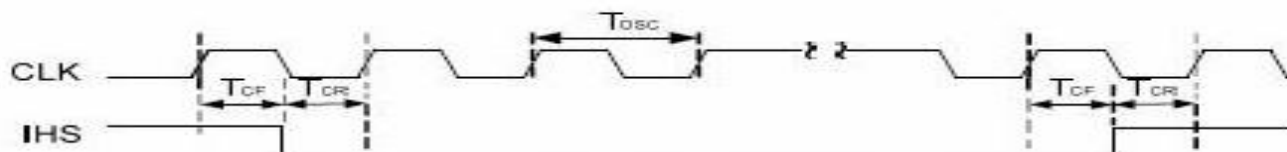**Figure 4 Data Transaction Timing in Parallel RGB (24 bit) Interface (DE Mode)**

7.1.1 Clock and Sync waveforms

Figure 6 CLK and IHS timing waveform
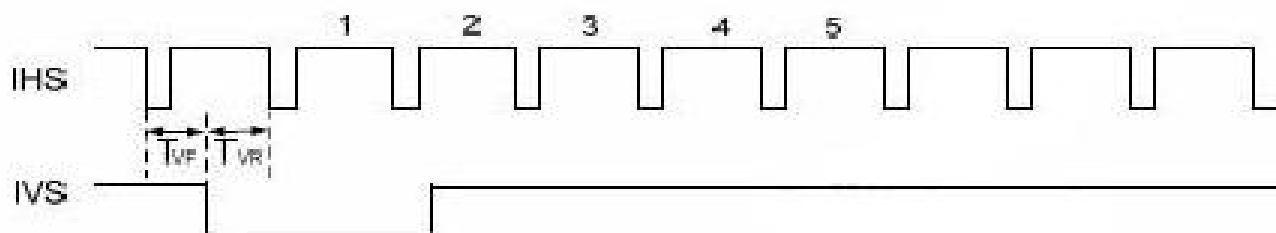
Figure 7 IHS and IVS timing waveforms
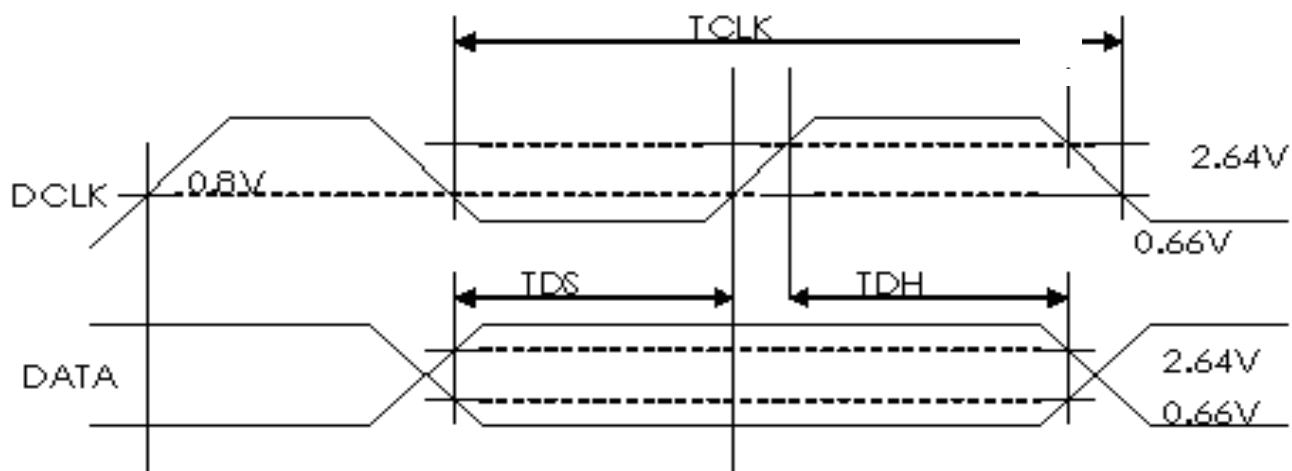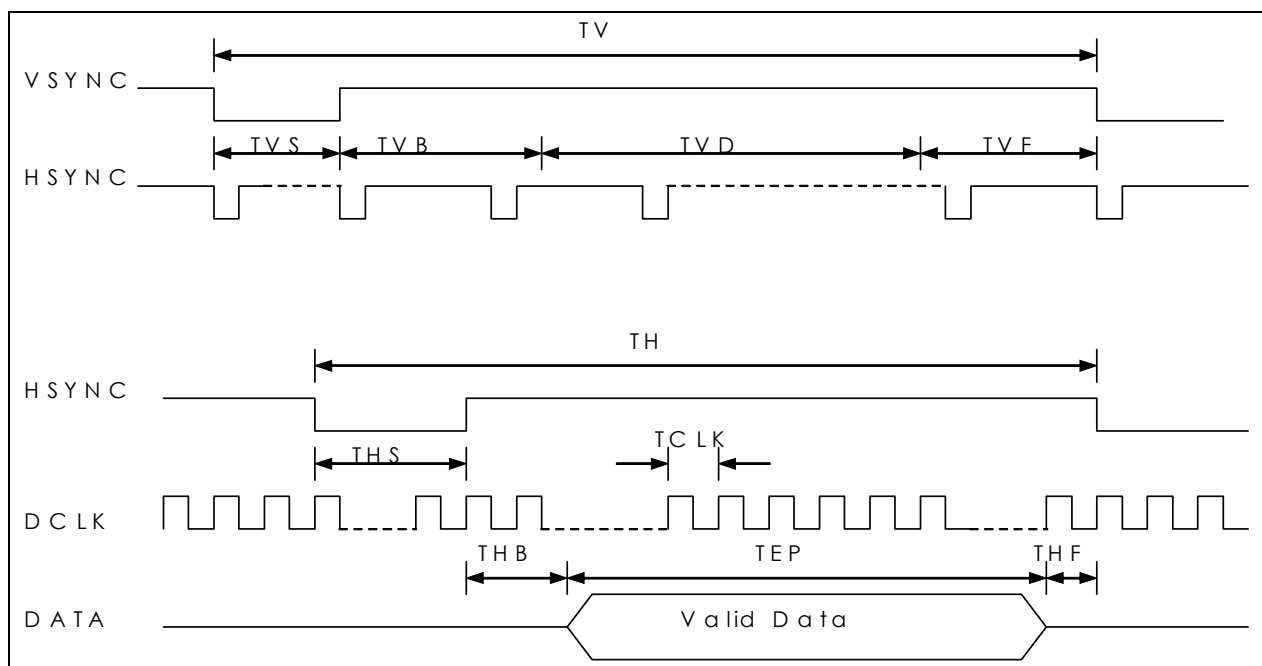
7.2 Reset Timing Chart

The RESET input must be held at least 1ms after power is stable
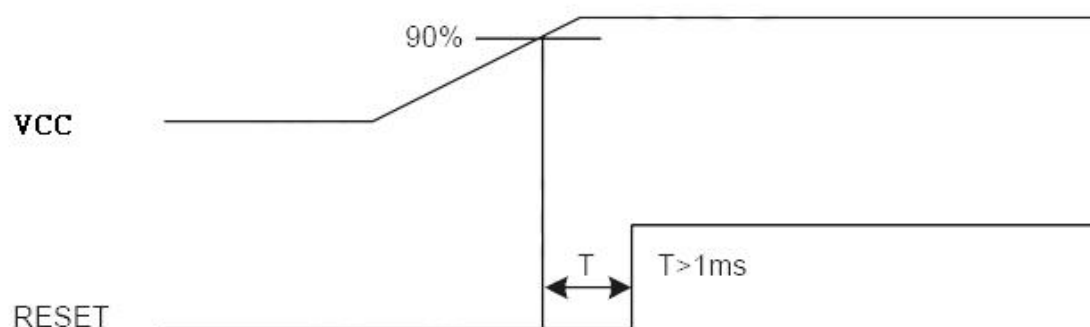
Reset timing

8. OPTICAL CHARACTERISTIC

Ta=25±2℃, ILED=20mA

Item		Symbol	Condition	Min.	Typ.	Max.	Unit	Remark
Response time		Tr	θ=0°、Φ=0°	-	10	20	ms	Note 3,
		Tf		-	15	30	ms	
Contrast ratio		CR	At optimized viewing angle	300	400	-	-	Note 4,
Color Chromaticity	White	Wx	θ=0°、Φ=	0.26	0.31	0.36		Note 2,6,7
		Wy		0.28	0.33	0.38		
Viewing angle	Hor.	ΘR	CR≧10	50	60		Deg.	Note 1
		ΘL		50	60			
	Ver.	ΦT		40	50			
		ΦB		45	55			
Brightness		-	-	200	300	-	cd/m^2	Center of display

Ta=25±2℃, I_L=20mA

Note 1: Definition of viewing angle range
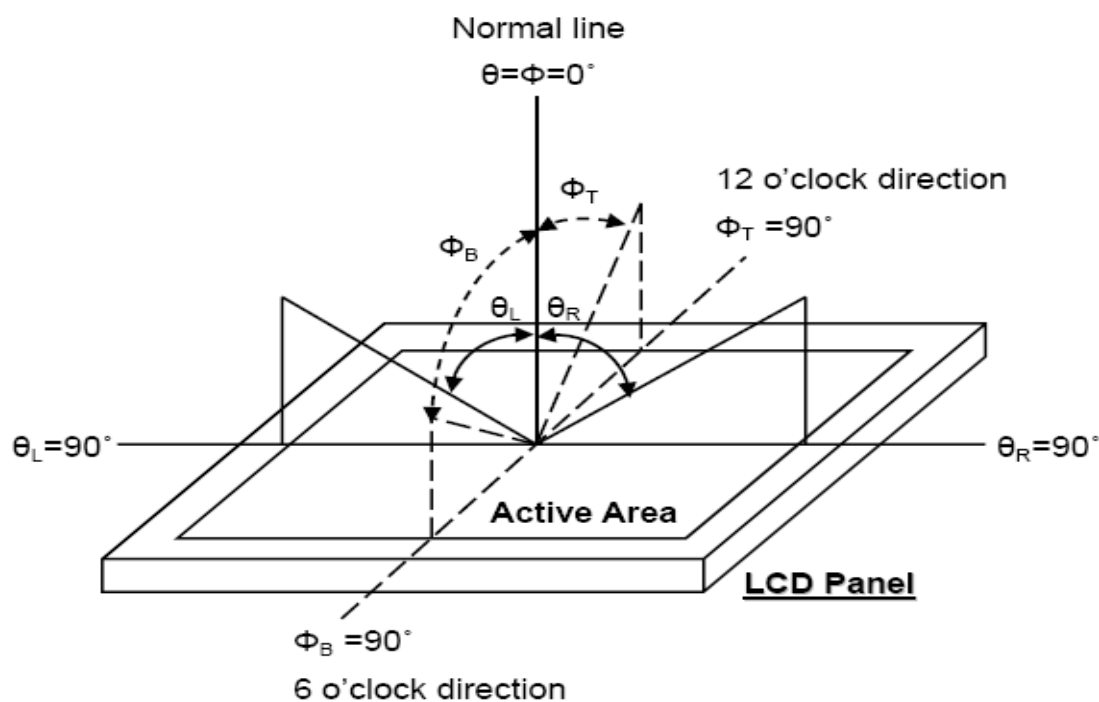
Fig. 8-1 Definition of viewing angle

Note 2: Test equipment setup:

After stabilizing and leaving the panel alone at a driven temperature for 10 minutes, the measurement should be executed. Measurement should be executed in a stable, windless, and dark room. Optical specifications are measured by Topcon BM-7 luminance meter 1.0° field of view at a distance of 50cm and normal direction.
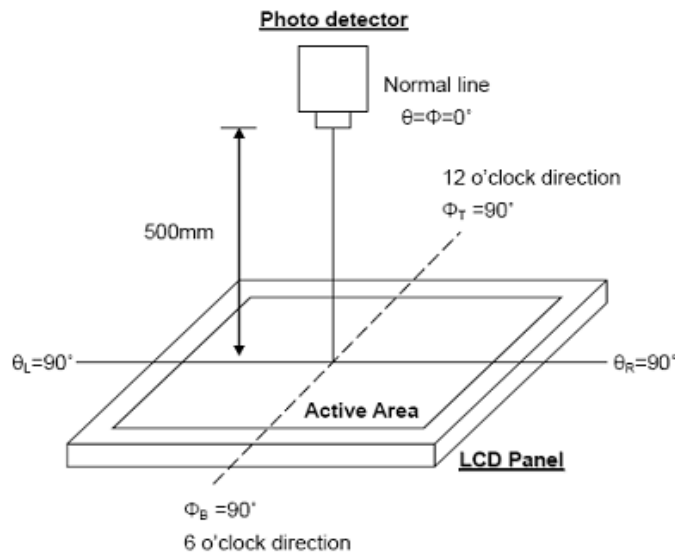
Fig. 8-2 Optical measurement system setup

Note 3: Definition of Response time:
The response time is defined as the LCD optical switching time interval between "White" state and"Black" state. Rise time, Tr, is the time between photo detector output intensity changed from 90％ to 10％ . And fall time, Tf, is the time between photo detector output intensity changed from10％ to 90％ .
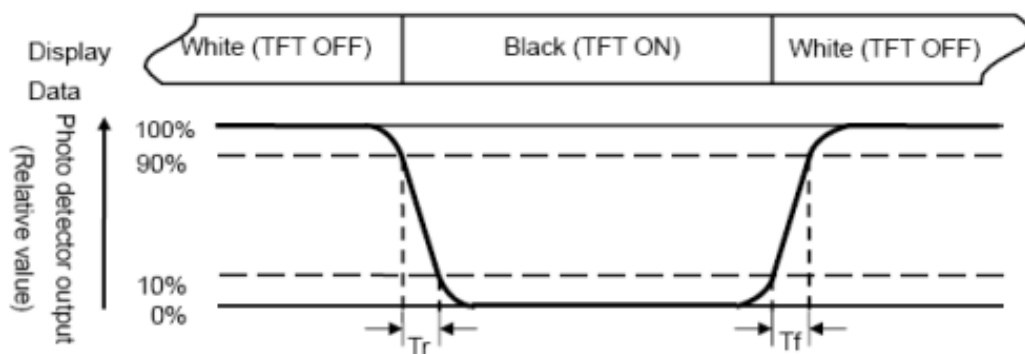
Fig. 3-3 Definition of response time

Note 4: Definition of contrast ratio:
The contrast ratio is defined as the following expression.

$$\text{Contrast ratio (CR)} = \frac{\text{Luminance measured when LCD on the "White" state}}{\text{Luminance measured when LCD on the "Black" state}}$$

Note 5: Definition of color chromaticity (CIE 1931)
Color coordinates measured at the center point of LCD

Note 6: Measured at the center area of the panel when all the input terminals of LCD panel are electrically opened.

Note 7 : Uniformity (U) = $\dfrac{\text{Brightness (min)}}{\text{Brightness (max)}}$ x 100%

9. INTERFACE

9.1. LCM PIN Definition

Pin	Symbol	I/O	Function	Remark
1	LED-	I	Backlight LED Ground	
2	LED-	I	Backlight LED Ground	
3	LED+	I	Backlight LED Power	
4	LED+	I	Backlight LED Power	
5	TOUCH_PANEL_Y1	O	LCD Touch Panle Y1	
6	TOUCH_PANEL_X1	O	LCD Touch Panle X1	
7	NC	-	Not Use	
8	/RESET	-	Hardware Reset	
9	SPENA	I	SPI Interface Data Enable Signal	Note 3
10	SPCLK	I	SPI Interface Data Clock	Note 3
11	SPDAT	I	SPI Interface Data	Note 3
12	B0	I	Blue Data Bit 0	
13	B1	I	Blue Data Bit 1	
14	B2	I	Blue Data Bit 2	
15	B3	I	Blue Data Bit 3	
16	B4	I	Blue Data Bit 4	
17	B5	I	Blue Data Bit 5	
18	B6	I	Blue Data Bit 6	
19	B7	I	Blue Data Bit 7	
20	G0	I	Green Data Bit0	
21	G1	I	Green Data Bit1	
22	G2	I	Green Data Bit2	
23	G3	I	Green Data Bit3	
24	G4	I	Green Data Bit4	
25	G5	I	Green Data Bit5	
26	G6	I	Green Data Bit6	
27	G7	I	Green Data Bit7	
28	R0	I	Red Data Bit0 /DX0	Note 4
29	R1	I	Red Data Bit1 /DX1	Note 4
30	R2	I	Red Data Bit2 /DX2	Note 4
31	R3	I	Red Data Bit3 /DX3	Note 4
32	R4	I	Red Data Bit4 /DX4	Note 4

33	R5	I	Red Data Bit5 /DX5	Note 4
34	R6	I	Red Data Bit6 /DX6	Note 4
35	R7	I	Red Data Bit7 /DX7	Note 4
36	HSYNC	I	Horizontal Sync Input	
37	VSYNC	I	Vertical Sync Input	
38	DCLK	I	Dot Data Clock	
39	NC	-	Not Use	
40	NC	-	Not Use	
41	Vcc	I	Digital Power	
42	Vcc	I	Digital Power	
43	TOUCH_PANEL_Y2	O	LCD Touch Panel Y2	
44	TOUCH_PANEL_X2	O	LCD Touch Panel X2	
45	NC	-	Internal test use	
46	NC	-	Not Use	
47	NC	-	Internal test use	
48	SEL2	I	Control the input data format /floating	Note 1
49	SEL1	I	Control the input data format	Note 1,5
50	SEL0	I	Control the input data format	Note 1,5
51	NC	-	Not Use	
52	DE	I	Data Enable Input	Note 2
53	DGND	I	Ground	
54	AVSS	I		

Note:

  1. The mode control (SEL2) not use, it can't control CCIR601 interface. If not use CCIR601, it can floating.

  2. For digital RGB input data format, both SYNC mode and DE+SYNC mode are supported. If DE signal is fixed now, SYNC mode is used. Otherwise, DE+SYNC mode is used. Suggest used SYNC mode. Suggest the DE signal usually pull low.

  3. Usually pull high.

  4. IF select serial RGB or CCIR601/656 input mode is selected, only DX0-DX7 used, and the other short to GND, only selected serial RGB、CCIR601/656 interface, DX BUS will enable. Digital input mode DX0 is LSB and DX7 is MSB.

5. Control the input data format

SEL 2-0: Define the input interface mode.

SEL2	SEL1	SEL0	Format	Operating Frequency
0	0	0	Parallel-RGB data format (only support stripe type color filter)	6.5MHz
0	0	1	Serial-RGB data format	19.5MHz
0	1	0	CCIR 656 data format (640RGB)	24.54MHz
0	1	1	CCIR 656 data format (720RGB)	27MHz
1	0	0	YUV mode A data format (Cr-Y-Cb-Y)	24.54MHz
1	0	1	YUV mode A data format (Cr-Y-Cb-Y)	27MHz
1	1	0	YUV mode B data format (Cb-Y-Cr-Y)	27MHz
1	1	1	YUV mode B data format (Cb-Y-Cr-Y)	24.54MHz

Input format	DOTCLK Freq (MHz)	Display Data	Active Area (DOTCLK)
YUV mode	24.54	640	1280
	27	720	1440

Mode	D[23:16]	D[15:8]	D[7:0]	IHS	IVS	DEN
ITU-R BT 656	D[23:16]	GND	GND	NC	NC	NC
ITU-R BT 601	D[23:16]	GND	GND	IHS	IVS	NC
8 bit RGB	D[23:16]	GND	GND	IHS	IVS	NC for HV Mode DEN for DEN Mode
24 bit RGB	R[7:0]	G[7:0]	B[7:0]	IHS	IVS	NC for HV Mode DEN for DEN Mode

9.2 SPI timing Characteristics

PARAMETER	Symbol	Min.	Typ.	Max.	Unit
SPCK period	T_{CX}	60	-	-	ns
SPCK high width	T_{CXH}	30	-	-	ns
SPCK low width	T_{CXL}	30	-	-	ns
Data setup time	T_{SU1}	12	-	-	ns
Data hold time	T_{HD1}	12	-	-	ns
SPENA to SPCK setup time	T_{CS}	20	-	-	ns
SPENA to SPDA hold time	T_{CE}	20	-	-	ns
SPENA high pulse width	T_{CO}	50	-	-	ns
SPDA output latency	T_{CR}	-	1/2	-	T_{CX}
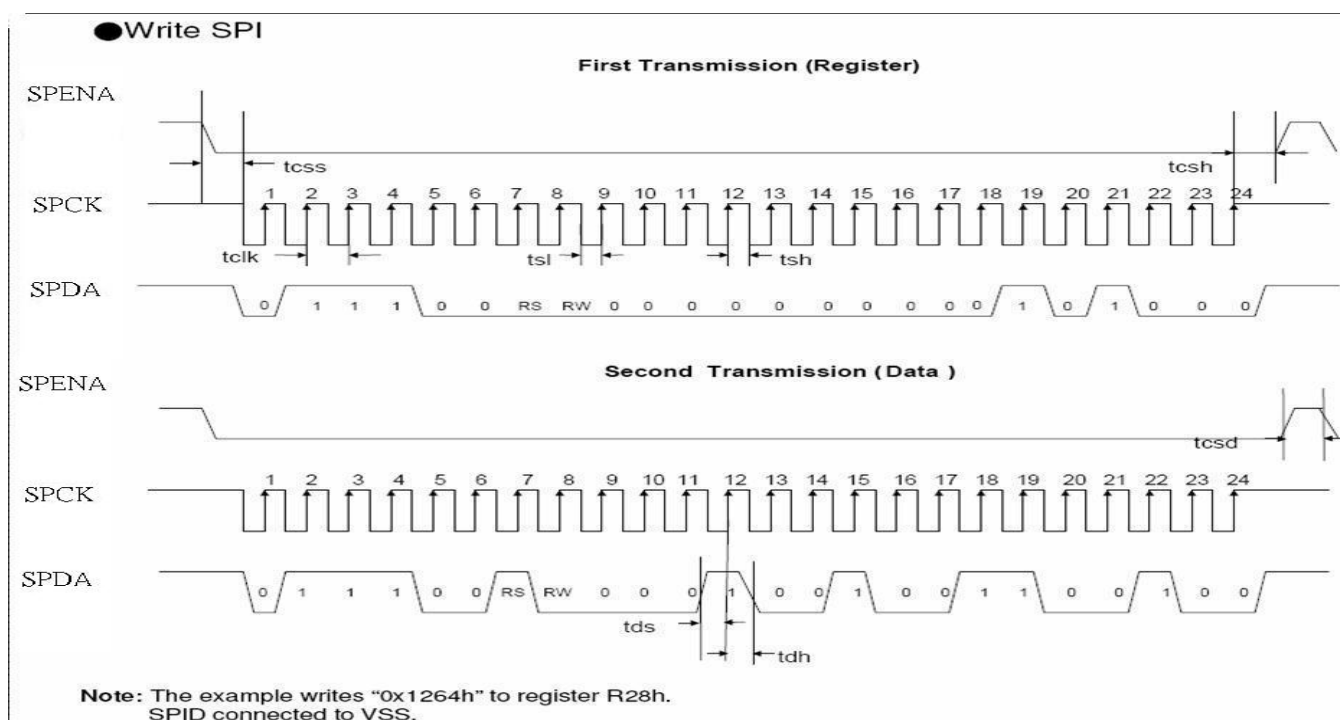
Figure 8 SPI read、write timing
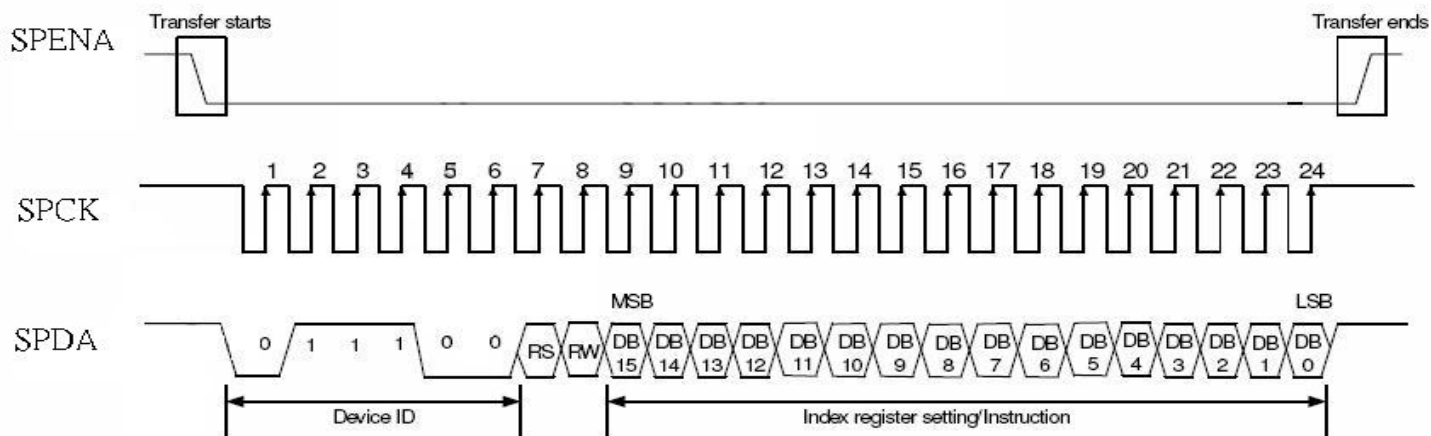
Figure 9 SPI timing

9.3 Basic Display Color and Gray Scale

Color		Input Color Data																							
		Red								Green								Blue							
		MSB							LSB	MSB							LSB	MSB							LSB
		R7	R6	R5	R4	R3	R2	R1	R0	G7	G6	G5	G4	G3	G2	G1	G0	B7	B6	B5	B4	B3	B2	B1	B0
Basic Colors	Black	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Red(255)	1	1	1	1	1	1	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Green(255)	0	0	0	0	0	0	0	0	1	1	1	1	1	1	1	1	0	0	0	0	0	0	0	0
	Blue(255)	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1	1	1	1	1	1	1
	Cyan	0	0	0	0	0	0	0	0	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
	Magenta	1	1	1	1	1	1	1	1	0	0	0	0	0	0	0	0	1	1	1	1	1	1	1	1
	Yellow	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	0	0	0	0	0	0	0	0
	White	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
Red	Red(0) Dark	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Red(1)	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Red(2)	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:
	Red(253)	1	1	1	1	1	1	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Red(254)	1	1	1	1	1	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Red(255) Bright	1	1	1	1	1	1	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Green	Green(0) Dark	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Green(1)	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0
	Green(2)	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0
	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:
	Green(253)	0	0	0	0	0	0	0	0	1	1	1	1	1	1	0	1	0	0	0	0	0	0	0	0
	Green(254)	0	0	0	0	0	0	0	0	1	1	1	1	1	1	1	0	0	0	0	0	0	0	0	0
	Green(255)Bright	0	0	0	0	0	0	0	0	1	1	1	1	1	1	1	1	0	0	0	0	0	0	0	0
Blue	Blue(0) Dark	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Blue(1)	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1
	Blue(2)	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0
	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:
	Blue(253)	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1	1	1	1	1	0	1
	Blue(254)	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1		1	1	1	1	1	0
	Blue(255) Bright	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1		1	1	1	1	1	1

10. BLOCK DIAGRAM

TFT LCD Panel

Single chip with Vcom,Vgl, Vgh
T-CON

Digital24-bits,CCIR656,
CCIR601,SERIAL RGB,
SPCLK, SPDAT, Hsync,

EXTERNAL

CUSTOMER'S SYSTEM

Panel Interface
FPC

V_{BL+}

V_{BL-}

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Facelcd(HongKong) Limited
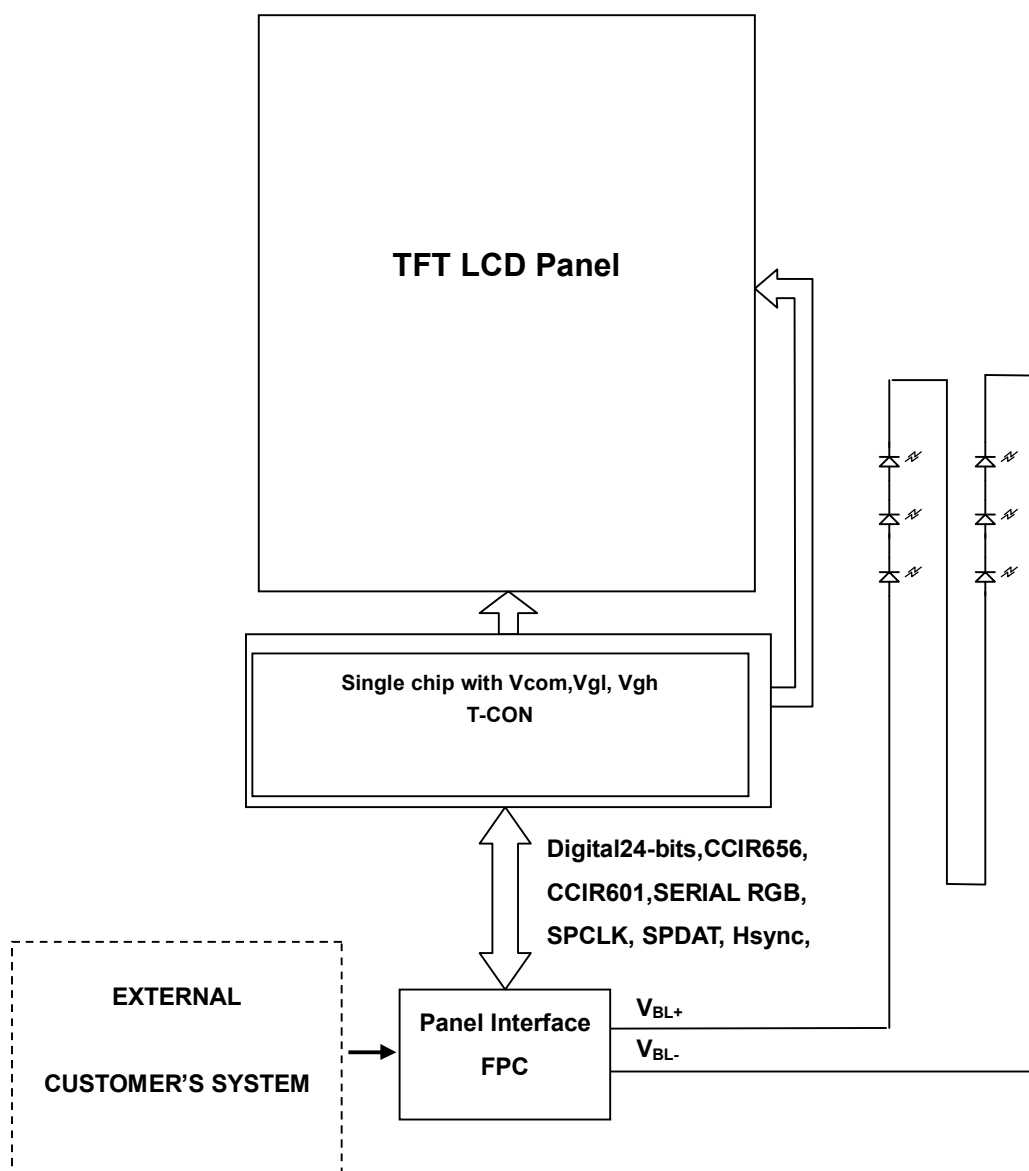
11. QUALITY ASSURANCE

No.	Test Items	Test Condition	REMARK
1	High Temperature Storage Test	Ta=80℃ Dry 240h	
2	Low Temperature Storage Test	Ta=-30℃ Dry 240h	
3	High Temperature Operation Test	Ta=70℃ Dry 240h	
4	Low Temperature Operation Test	Ta=-20℃ Dry 240h	
5	High Temperature and High Humidity Operation Test	Ta=60℃ 90%RH 240h	
6	Electro Static Discharge Test	Panel surface / top case. Contact / Air：±6KV / ±8KV，150pF，330Ω	Non-operating
7	Shock Test (non-operating)	Shock Level：100G Waveform : Half Sinusoidal Wave Shock Time : 6ms Number of Shocks : 3 times for each ±X, ±Y, ±Z direction	
8	Vibration Test (non-operating)	Frequency range: 10Hz ~ 550Hz Stoke：1.3mm Sweep : 1.5G, 33.3~400Hz Vibration : Sinusoidal Wave, 1Hrs for X,YZ direction.	
9	Thermal Shock Test	-20℃(0.5h)~70℃(0.5h) / 100 cycles	

Ta= Ambient Temperature

Note:

1. The test samples have recovery time for 2 hours at room temperature before the function check. In the standard conditions, there is no display function NG issue occurred.
2. All the cosmetic specifications are judged before the reliability stress.
3. After the reliability test, the product only guarantees operation , but don't guarantee all of the cosmetic specification.

12. OUTLINE DRAWING

13. PACKAGE INFORMATION

13.1 Packaging Material Table

No.	Item	Model(Material)	Dimension(mm)	Unit Weight(kg)	Quantity（pcs）	Remark
1	LCM Module	FB035XHG304-A	76.9×63.9×3.26	0.030	260	
2	Corrugated Board-1	BC Corrugated Paper	510×343	0.130	2	
3	Corrugated Board-2	B Corrugated Paper	1152×512	0.260	1	
4	Corrugated Bar	B Corrugated Paper	343×104	0.020	12	
5	Partition	BC Corrugated Paper	512×342×106	1.045	2	
6	Dust-Proof Bag	PE	700×530	0.060	1	
7	A/S Bag	PE	112×90	$1.11×10^{-3}$	260	
8	Carton	Corrugated Paper	530×355×255	1.100	1	
9	Total weight	12.10±5%				

13.2 Packaging Quantitiy

LCM quantity per Partition: 2 row × 21 pcs + 4 row × 22 pcs = 130 pcs
Total LCM quantity in Carton: 2 layer ×130 pcs per Partition = 260 pcs

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Carton Label

crepe paper tape

Anti-Static bag

LCM

(1) Box Dimensions : 525(L)*362(W)*250(H)
(2) 260panel/Carton

每層130pcs，共兩層

Sea & Land & Air Transportation (運空)

View AirFor Corron
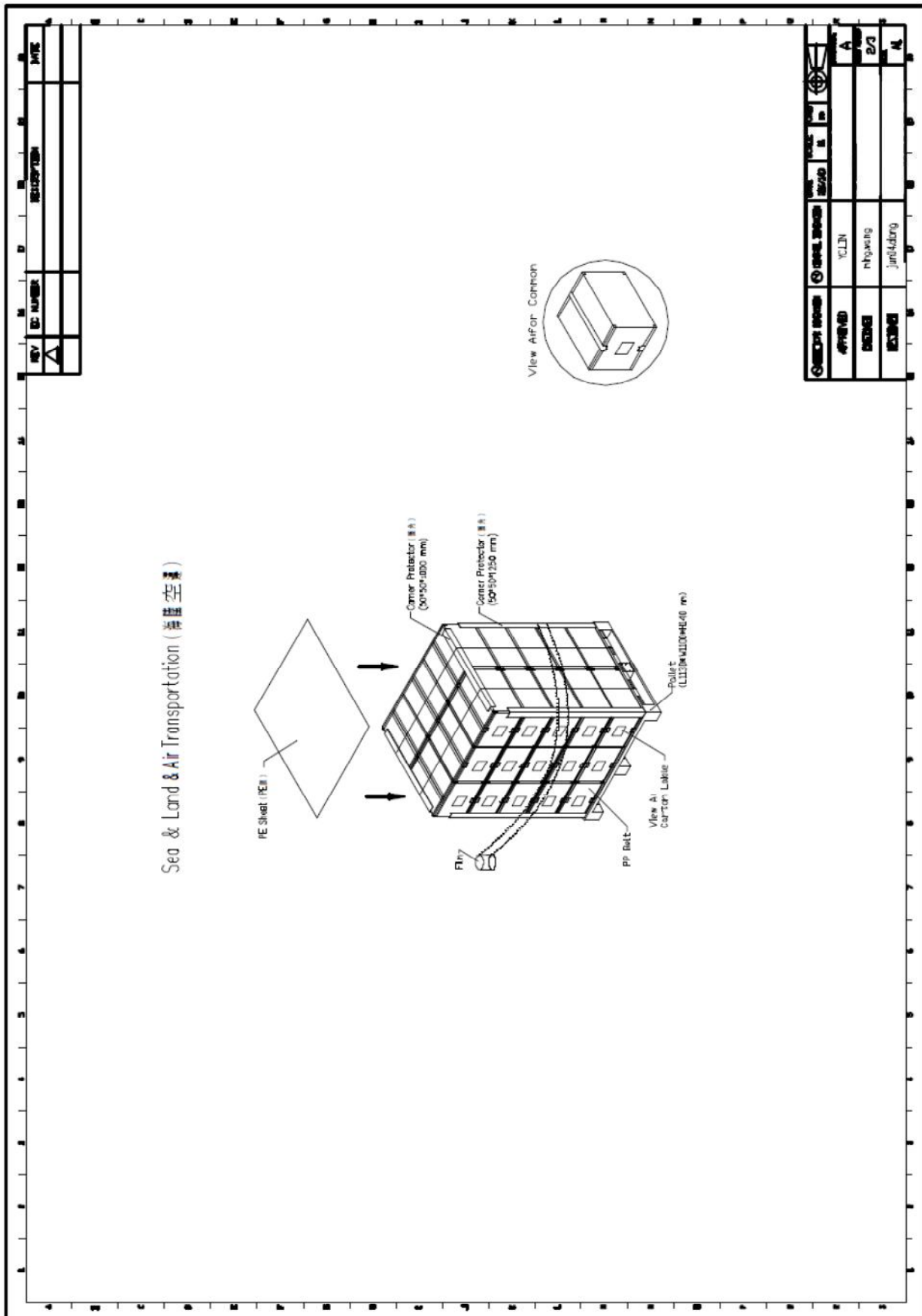
14 RECAUTIONS

Please pay attention to the following when you use this TFT LCD module.

14.1 MOUNTING PRECAUTIONS

(1) You must mount a module using arranged in four corners or four sides.

(2) You should consider the mounting structure so that uneven force (ex. Twisted stress) is not applied to the module.
   And the case on which a module is mounted should have sufficient strength so that external force is not transmitted directly to the module.

(3) Please attach a transparent protective plate to the surface in order to protect the polarizer.
   Transparent protective plate should have sufficient strength in order to the resist external force.

(4) You should adopt radiation structure to satisfy the temperature specification.

(5) Acetic acid type and chlorine type materials for the cover case are not describe because the former generates corrosive gas of attacking the polarizer at high temperature and the latter causes circuit break by electro-chemical reaction.

(6) Do not touch, push or rub the exposed polarizers with glass, tweezers or anything harder than HB pencil lead. And please do not rub with dust clothes with chemical treatment.
   Do not touch the surface of polarizer for bare hand or greasy cloth. (Some cosmetics are determined to the polarizer)

(7) When the surface becomes dusty, please wipe gently with adsorbent cotton or other soft materials like chamois soaks with petroleum benzene. Normal-hexane is recommended for cleaning the adhesives used to attach front / rear polarizers. Do not use acetone, toluene and alcohol because they cause chemical damage to the polarizer.

(8) Wipe off saliva or water drops as soon as possible. Their long time contact with polarizer causes deformations and color fading.

(9) Do not open the case because inside circuits do not have sufficient strength.

14.2 OPERATING PRECAUTIONS

(1) The spike noise causes the mis-operation of circuits. It should be lower than following voltage：
   V=±200mV(Over and under shoot voltage)

(2) Response time depends on the temperature. (In lower temperature, it becomes longer.)

(3) Brightness depends on the temperature. (In lower temperature, it becomes lower)
   And in lower temperature, response time (required time that brightness is stable after turned on) becomes longer.

(4) Be careful for condensation at sudden temperature change. Condensation makes damage to polarizer or electrical contacted parts. And after fading condensation, smear or spot will occur.

(5) When fixed patterns are displayed for a long time, remnant image is likely to occur.

(6) Module has high frequency circuits. Sufficient suppression to the electromagnetic interference shall be done by system manufacturers. Grounding and shielding methods may be important to minimize

the interference.

14.3 ELECTROSTATIC DISCHARGE CONTROL

Since a module is composed of electronic circuits, it is not strong to electrostatic discharge. Make certain that treatment persons are connected to ground through wristband etc. And don't touch interface pin directly.

14.4 PRECAUTIONS FOR STRONG LIGHT EXPOSURE

Strong light exposure causes degradation of polarizer and color filter.

14.5 STORAGE

When storing modules as spares for a long time, the following precautions are necessary.

(1) Store them in a dark place. Do not expose the module to sunlight or fluorescent light. Keep the temperature between 5℃ and 35℃ at normal humidity.

(2) The polarizer surface should not come in contact with any other object. It is recommended that they be stored in the container in which they were shipped.

14.6 HANDLING PRECAUTIONS FOR PROTECTION FILM

(1) When the protection film is peeled off, static electricity is generated between the film and polarizer. This should be peeled off slowly and carefully by people who are electrically grounded and with well ion-blown equipment or in such a condition, etc.

(2) The protection film is attached to the polarizer with a small amount of glue. Is apt to remain on the polarizer. Please carefully peel off the protection film without rubbing it against the polarizer.

(3) When the module with protection film attached is stored for a long time, sometimes there remains a very small amount of glue still on the polarizer after the protection film is peeled off. You can remove the glue easily.

(4) When the glue remains on the polarizer surface or its vestige is recognized, please wipe them off with absorbent cotton waste or other soft material like chamois soaked with normal-hexane.