



**Display Future Ltd**

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## **LCD MODULE SPECIFICATION**

**Model: DF-TFR0345FB-M1**

**This module uses ROHS materials**

### **For customer acceptance**

Customer		date
Approved		
Comments		

The standard product specification may change without prior notice in order to improve performance or quality. Please contact Display Future Ltd for updated specification and product status before design for the standard product or release of the order.

Revision	1.3
Engineering	
Date	2018/01/4
Our Reference	

## REVISION RECORD

[illegible]

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**■ GENERAL INFORMATION**

Item	Contents	Unit
LCD type	TFT/Transmissive/Positive	/
Size	3.5	Inch
Viewing direction	12:00(without image inversion and least brightness change)	O' Clock
Gray scale inversion direction	6:00(contrast peak located at)	O'Clock
LCM (W × H × D )	76.90×63.90×4.35	mm <sup>3</sup>
Active area (W×H)	70.08×52.56	mm <sup>2</sup>
Pixel pitch (W×H)	0.219×0.219	mm <sup>2</sup>
Number of dots	320 (RGB) × 240	/
Driver IC	HX8238D	/
Backlight type	6 LEDs	/
Interface type	24 bit RGB/ Serial RGB/CCIR/YUV	/
Color depth	16.7M	/
Pixel configuration	R.G.B vertical stripe	/
Top polarizer surface treatment	Anti-glare	/
Input voltage	3.3	V
With/Without TSP	With TSP	/
Weight	TBD	g

Note 1: RoHS compliant;

Note 2: LCM weight tolerance: ± 5% .

The figure consists of three mechanical drawings of the LED module:

- Top View:** Shows the rectangular footprint of the module. Dimensions include overall width 76.50±0.2 mm, mounting hole pitch 7.62 mm, and various offset dimensions from the edges to the mounting holes (e.g., 0.30 mm, 1.03 mm, 1.20 mm). The central area is labeled "320•R6B•240". Corner reference points are marked as YU, XR, XL, and YD.
- Side View:** Shows the profile of the module, indicating a total height of 4.35±0.3 mm and a base thickness of 3.20±0.2 mm.
- Bottom View:** Shows the underside of the module, highlighting the "PROTECTIVE TAPE" covering the solder joints. It includes a dimension of 4.00±0.5 mm for the tape coverage and a small step dimension of 3.00±0.3 mm.

PIN	DESCRIPTION
1	LEDK R1
2	LEDK R2
3	LEDA 31 R3
4	LEDA 32 R4
5	YU 33 R5
6	XR 34 R6
7	NC 35 R7
8	RESET 36 HSYNC
9	SPENA 37 VSYNC
10	SPCLK 38 DCLK
11	SPDAT 39 NC
12	B0 40 NC
13	B1 41 VDD
14	B2 42 VDD
15	B3 43 YD
16	B4 44 XL
17	B5 45 NC
18	B6 46 NC
19	B7 47 NC
20	G0 48 SEL2
21	G1 49 SEL1
22	G2 50 SEL0
23	G3 51 NC
24	G4 52 DEN
25	G5 53 GND
26	G6 54 GND
27	G7
28	R0

## ■ABSOLUTE MAXIMUM RATINGS

Parameter	Symbol	Min	Max	Unit
Supply voltage	VDD	-0.3	4.0	V
Input voltage for logic	VDDIO	-0.5	VCC+3.0	V
Operating temperature	T <sub>OP</sub>	-20	70	°C
Storage temperature	T <sub>ST</sub>	-30	80	°C
Humidity	RH	-	90%(Max60°C)	RH

## ■ELECTRICAL CHARACTERISTICS

### DC CHARACTERISTICS

Parameter	Symbol	Min	Typ	Max	Unit
Supply voltage	VDD	2.6	3.3	3.6	V
LCD power current	IDD	18	28	45	mA
Input voltage 'H' level	V <sub>IH</sub>	0.8VDD	-	VDD	V
Input voltage 'L' level	V <sub>IL</sub>	GND	-	0.2VDD	V
Output voltage 'H' level	V <sub>OH</sub>	0.8VDD	-	VDD	V
Output voltage 'L' level	V <sub>OL</sub>	GND	-	0.2VDD	V

## ■ BACKLIGHT CHARACTERISTICS

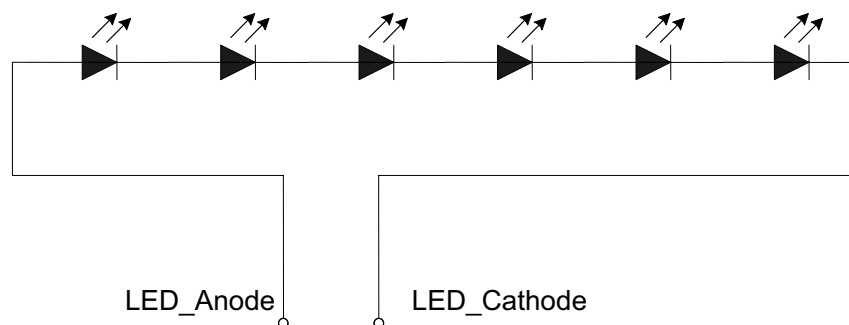
Item	Symbol	Min.	Typ.	Max.	Unit	Condition
Forward voltage	V <sub>f</sub>	-	19.2	20.4	V	Ta=25±2°C, 60%RH±5%
Forward current	I <sub>f</sub>	-	20	25	mA	
Power consumption	W <sub>BL</sub>	-	384	510	mW	
LED life time	-	30000	50000	-	Hrs	

Note :

Operating life time means brightness goes down to 50% initial brightness;

The life time of LED will be reduced if LED is driven by high current,high ambient temperature and humidity conditions;

Typical operating life time is an estimated data.



## ■ELECTRO-OPTICAL CHARACTERISTICS

Item		Symbol	Condition	Min	Typ	Max	Unit	Remark	Note
Response time		Tr+Tf	$\theta=0^\circ$ $\varnothing=0^\circ$ $T_a=25^\circ\text{C}$	---	50	80	ms	FIG 1.	4
Contrast ratio		Cr		200	350	---	---	FIG 2.	1
Luminance uniformity		$\delta$ WHITE		75	80	---	%	FIG 2.	3
Surface Luminance		Lv		500	600	---	$\text{cd/m}^2$	FIG 2.	2
Viewing angle range		$\theta$	$\varnothing = 90^\circ$	30	40	---	deg	FIG 3.	6
			$\varnothing = 270^\circ$	50	60	---	deg	FIG 3.	
			$\varnothing = 0^\circ$	50	60	---	deg	FIG 3.	
			$\varnothing = 180^\circ$	50	60	---	deg	FIG 3.	
CIE (x, y) chromaticity	Red	x	$\theta=0^\circ$ $\varnothing=0^\circ$ $T_a=25^\circ\text{C}$	0.609	0.639	0.669		FIG 2.	5
		y		0.314	0.344	0.374			
	Green	x		0.264	0.294	0.324			
		y		0.557	0.587	0.617			
	Blue	x		0.102	0.132	0.162			
		y		0.106	0.136	0.166			
	White	x		0.282	0.312	0.342			
		y		0.319	0.349	0.379			
NTSC	-	-	-	---	50	---	%	-	-

Note 1. Contrast Ratio(CR) is defined mathematically as For more information see FIG 2.

$$\text{Contrast Ratio} = \frac{\text{Average Surface Luminance with all white pixels (P1, P2, P3, P4, P5)}}{\text{Average Surface Luminance with all black pixels (P1, P2, P3, P4, P5)}}$$

Note 2. Surface luminance is the LCD surface from the surface with all pixels displaying white. For more information see FIG 2.

$$L_v = \text{Average Surface Luminance with all white pixels (P1, P2, P3, P4, P5)}$$

Note 3. The uniformity in surface luminance ,  $\delta$  WHITE is determined by measuring luminance at each test position 1 through 5, and then dividing the maximum luminance of 5 points luminance by minimum luminance of 5 points luminance. For more information see FIG 2.

$$\delta \text{ WHITE} = \frac{\text{Minimum Surface Luminance with all white pixels (P1, P2, P3, P4, P5)}}{\text{Maximum Surface Luminance with all white pixels (P1, P2, P3, P4, P5)}}$$

Note 4. Response time is the time required for the display to transition from White to black(Rise Time, Tr) and from black to white(Decay Time, Tf). For additional information see FIG 1. The test equipment is Autronic-Melchers's ConoScope. Series.

Note 5. CIE (x, y) chromaticity, The x, y value is determined by measuring luminance at each test position 1 through 5, and then make average value.

Note 6. Viewing angle is the angle at which the contrast ratio is greater than 2. For TFT module the contrast ratio is greater than 10. The angles are determined for the horizontal or x axis and the vertical or y axis with respect to the z axis which is normal to the LCD surface. For more information see FIG 3.

Note 7. For viewing angle and response time testing, the testing data is base on Autronic-Melchers's ConoScope. Series Instruments For contrast ratio, Surface Luminance, Luminance uniformity, CIE The test data is base on TOPCON's BM-5 photo detector.

FIG. 1 The definition of Response Time

The response time is defined as the following figure and shall be measured by switching the input signal for "black" and "white".

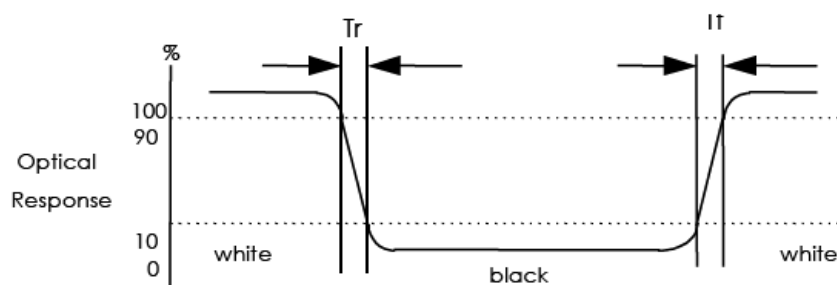


FIG. 2 Measuring method for Contrast ratio, surface luminance, Luminance uniformity, CIE (x, y) chromaticity

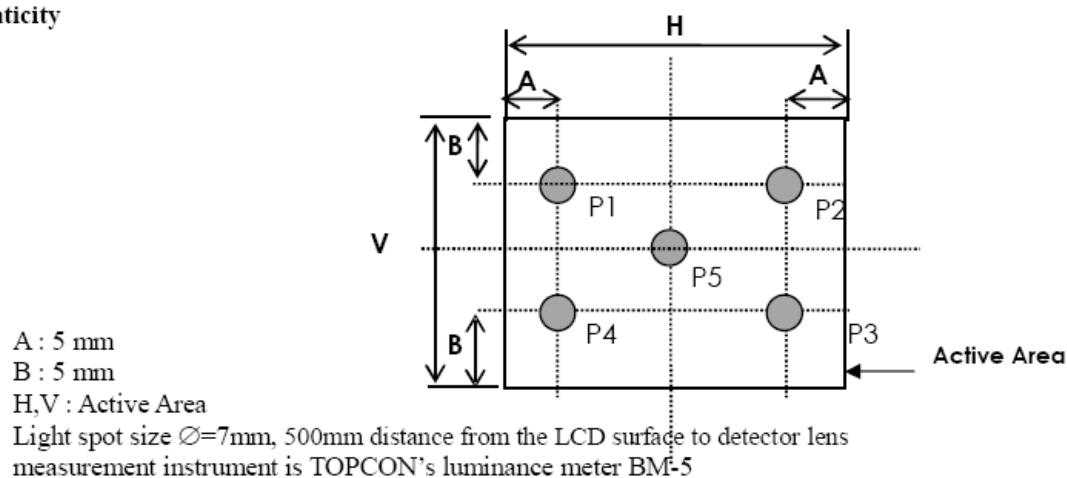
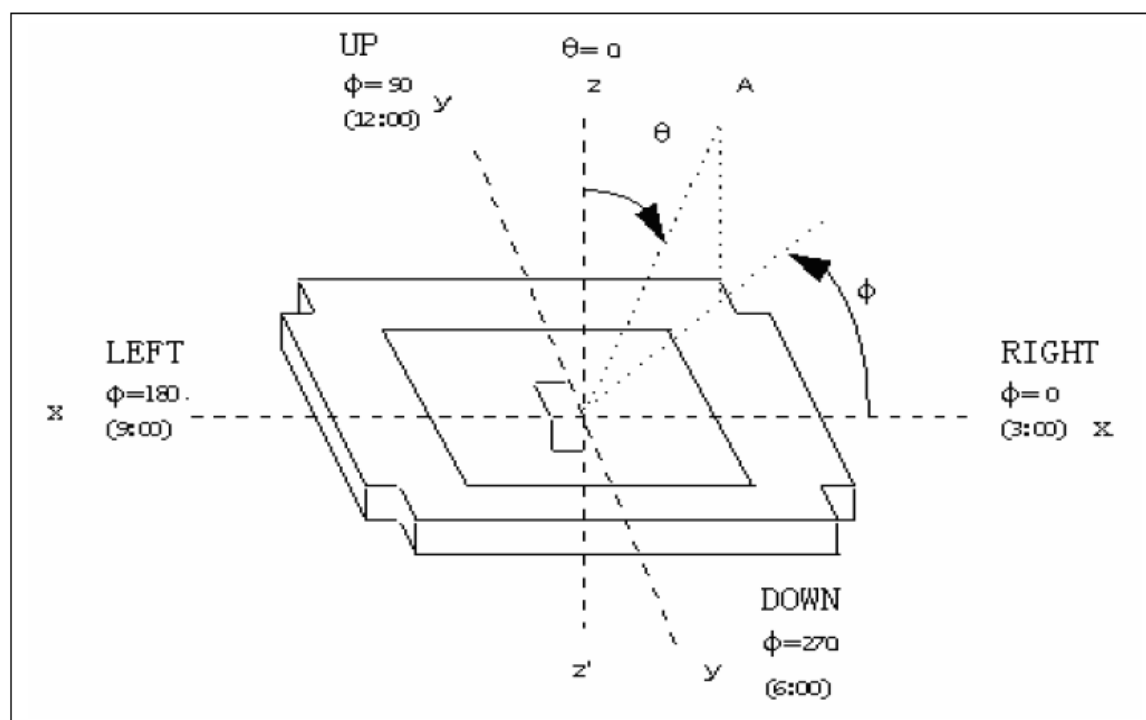


FIG. 3 The definition of viewing angle





**■ INTERFACE DESCRIPTION**

Pin No.	Symbol	Description
1	LEDK	Backlight LED Ground
2	LEDK	Backlight LED Ground
3	LEDA	Backlight LED Power
4	LEDA	Backlight LED Power
5	YU	Touch panel up side
6	XR	Touch panel right side
7	NC	Not Use
8	/RESET	Hardware Reset
9	SPENA	SPI Interface Data Enable Signal
10	SPCLK	SPI Interface Data Clock
11	SPDAT	SPI Interface Data
12	B0	Blue Data Bit 0
13	B1	Blue Data Bit 1
14	B2	Blue Data Bit 2
15	B3	Blue Data Bit 3
16	B4	Blue Data Bit 4
17	B5	Blue Data Bit 5
18	B6	Blue Data Bit 6
19	B7	Blue Data Bit 7
20	G0	Green Data Bit0
21	G1	Green Data Bit1
22	G2	Green Data Bit2
23	G3	Green Data Bit3
24	G4	Green Data Bit4
25	G5	Green Data Bit5
26	G6	Green Data Bit6
27	G7	Green Data Bit7
28	R0	Red Data Bit0 /DX0
29	R1	Red Data Bit1 /DX1
30	R2	Red Data Bit2 /DX2
31	R3	Red Data Bit3 /DX3
32	R4	Red Data Bit4 /DX4
33	R5	Red Data Bit5 /DX5
34	R6	Red Data Bit6 /DX6
35	R7	Red Data Bit7 /DX7

36	HSYNC	Horizontal Sync Input
37	VSYNC	Vertical Sync Input
38	DCLK	Dot Data Clock
39	NC	Not Use
40	NC	Not Use
41	VDD	Digital Power
42	VDD	Digital Power
43	YD	Touch panel bottom side
44	XL	Touch panel left side
45	NC	Not Use
46	NC	Not Use
47	NC	Not Use
48	SEL2	Control the input data format /floating
49	SEL1	Control the input data format
50	SEL0	Control the input data format
51	NC	Not Use
52	DEN	Data Enable Input
53	GND	Ground
54	GND	Ground

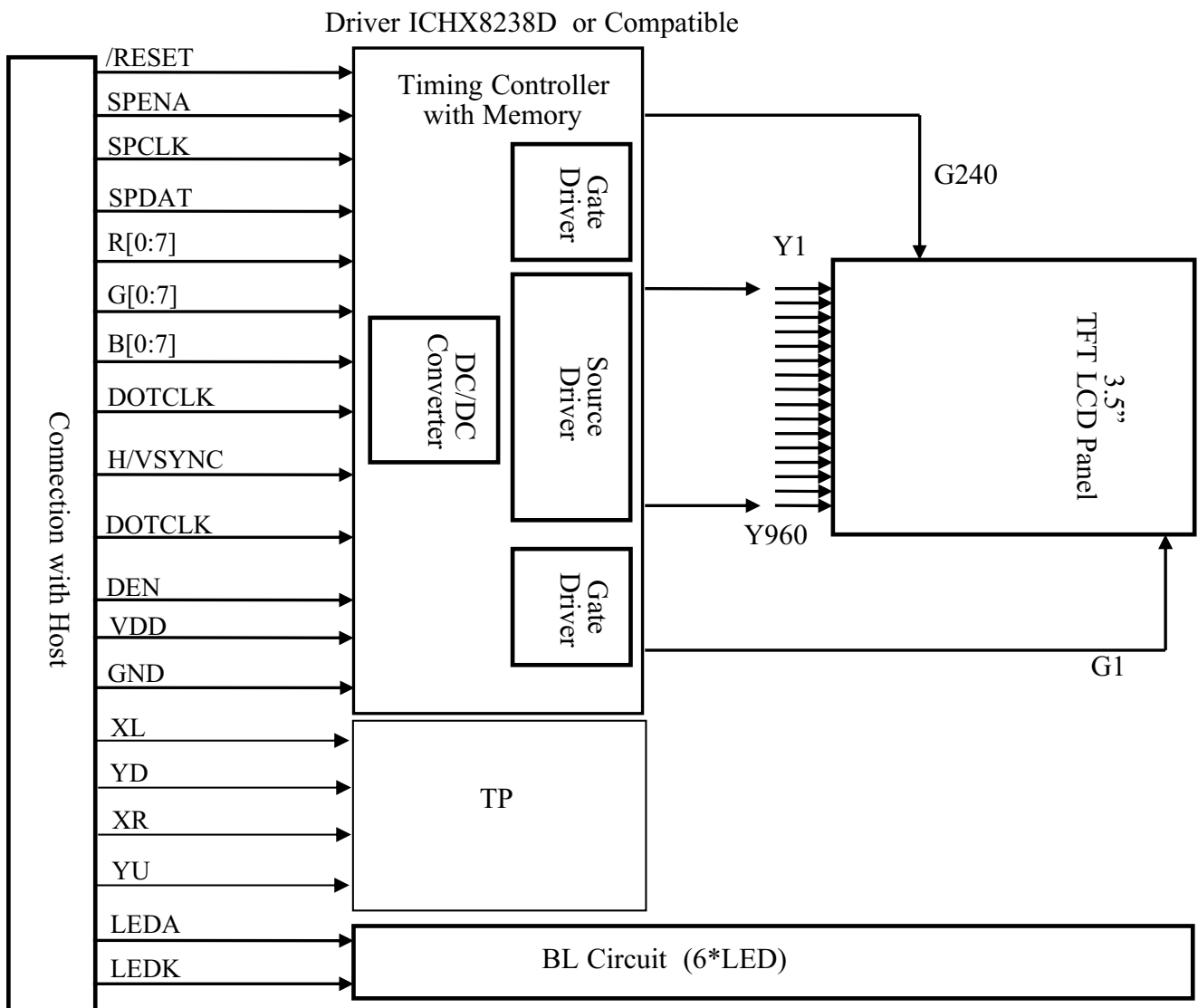
**Note:**

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 low, 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

SEL2	SEL1	SEL0	Interface Mode
0	0	0	Parallel-RGB Data format interface (only support stripe type color filter)
0	0	1	Serial-RGB data format
0	1	0	CCIR 656 data format (640RGB)
0	1	1	CCIR 656 data format (720RGB)
1	0	0	YUV mode A data format (Cr-Y-Cb-Y)
1	0	1	YUV mode A data format (Cr-Y-Cb-Y)
1	1	0	YUV mode B data format (Cb-Y-Cr-Y)
1	1	1	YUV mode B data format (Cb-Y-Cr-Y)

## ■ BLOCK DIAGRAM



## ■ APPLICATION NOTES

### 1.AC Characteristics

(Unless otherwise specified, Voltage Referenced to  $V_{SS}$ ,  $V_{DDIO} = 2.2V$ ,  $T_A = 25^\circ C$ )

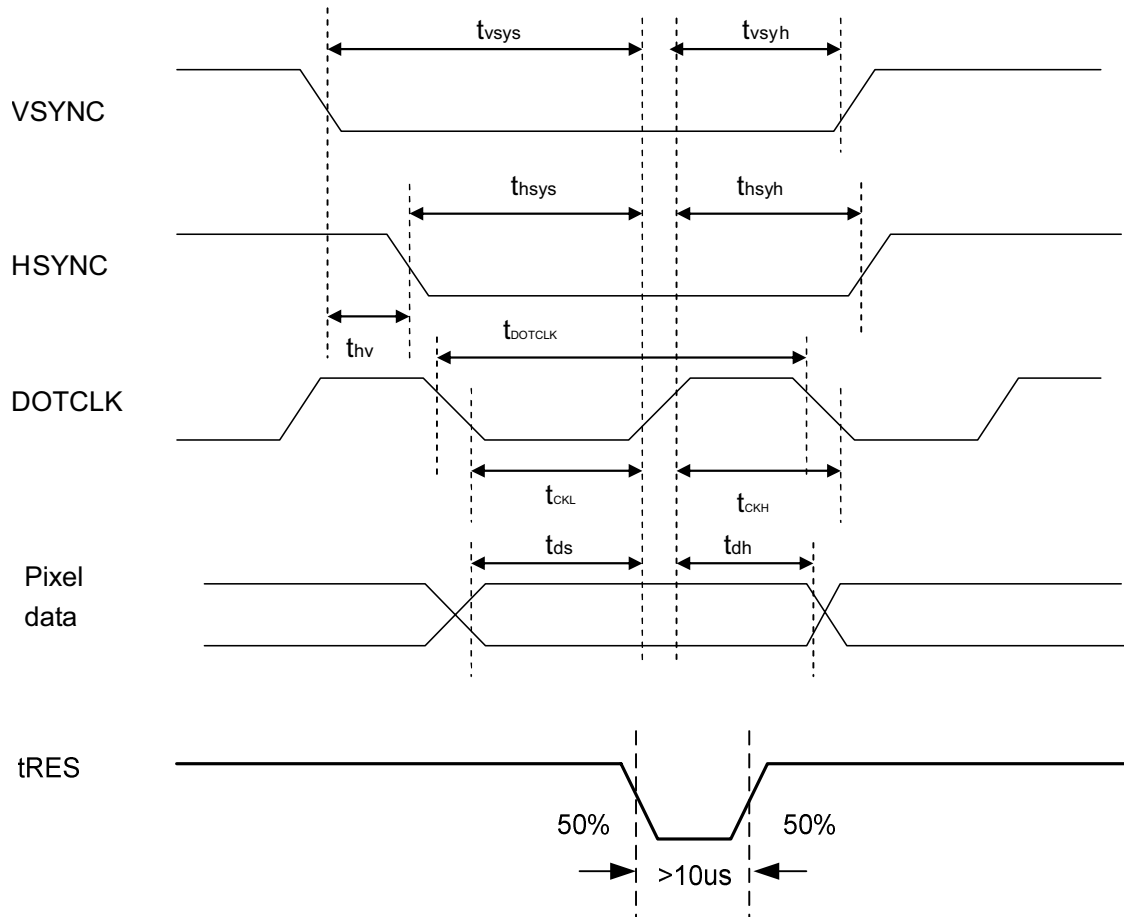
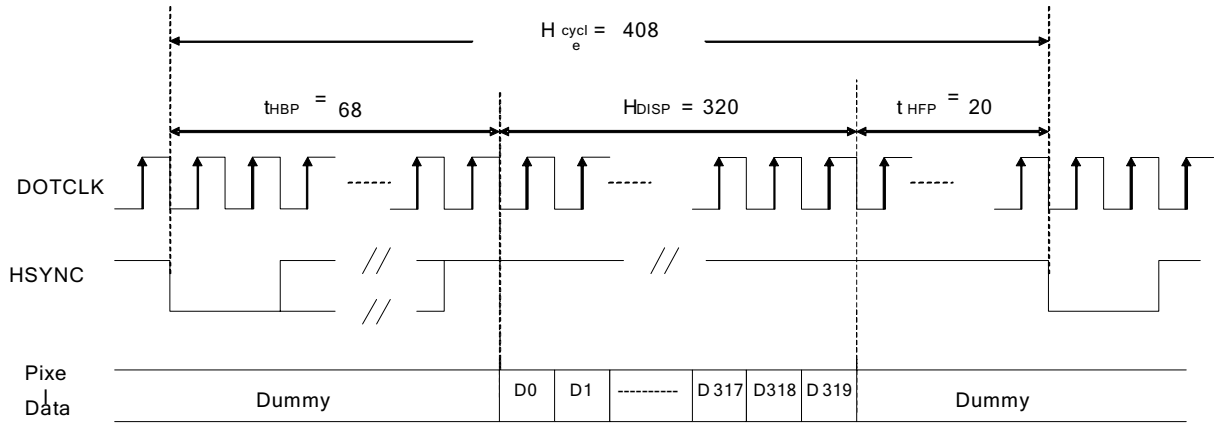


Figure 12.1 Pixel Timing

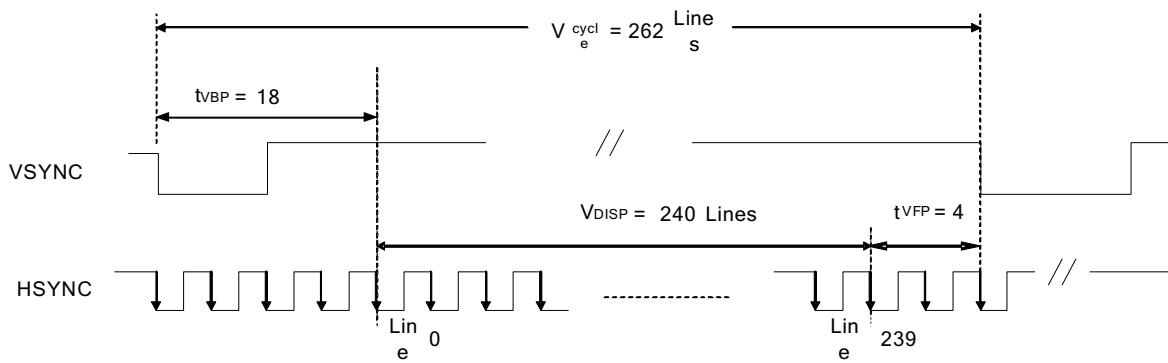
Characteristics	Symbol	Min.		Typ.		Max.		Unit
		24 bit	8 bit	24 bit	8 bit	24 bit	8 bit	
DOTCLK Frequency	fDOTCLK	-	-	6.5	19.5	10	30	MHz
DOTCLK Period	tDOTCLK	100	33.3	154	51.3	-	-	ns
Vertical Sync Setup Time	tvsys	20	10	-	-	-	-	ns
Vertical Sync Hold Time	tvsyh	20	10	-	-	-	-	ns
Horizontal Sync Setup Time	thsys	20	10	-	-	-	-	ns
Horizontal Sync Hold Time	thsyh	20	10	-	-	-	-	ns
Phase difference of Sync Signal Falling Edge	thv	1		-		240		tDOTCLK
DOTCLK Low Period	tCKL	50	15	-	-	-	-	ns
DOTCLK High Period	tCKH	50	15	-	-	-	-	ns
Data Setup Time	tds	12	10	-	-	-	-	ns
Data hold Time	tdh	12	10	-	-	-	-	ns
Reset pulse width	tRES	10		-		-		us

**Note:** External clock source must be provided to DOTCLK pin of HX8238-D. The driver will not operate if absent of the clocking signal.

Table1.1 Pixel Timing



a ) Horizontal Data Transaction Timing

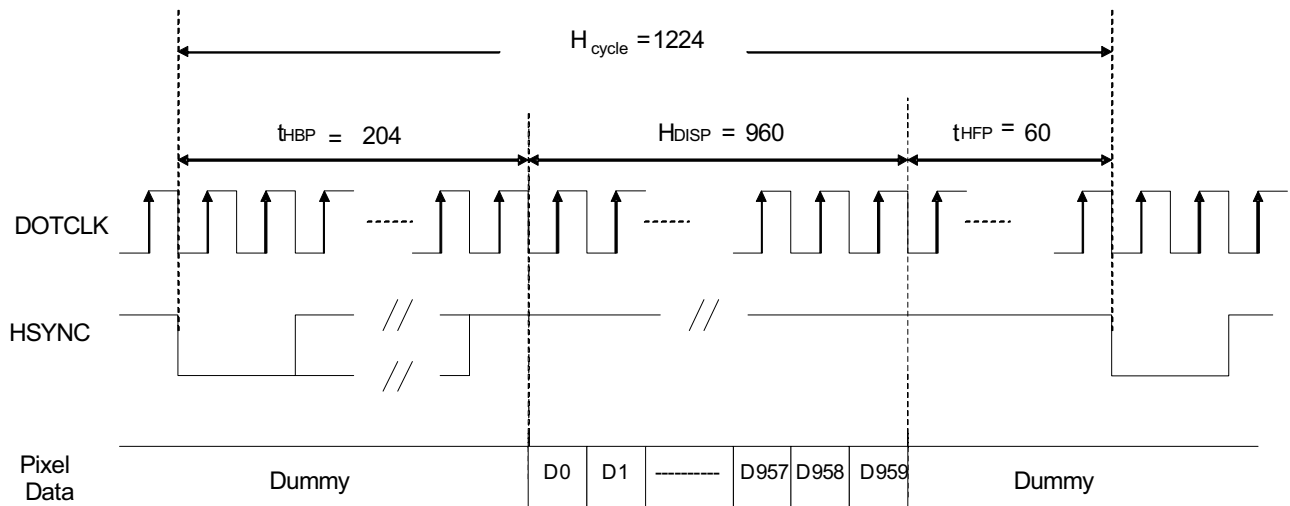


b ) Vertical Data Transaction Timing

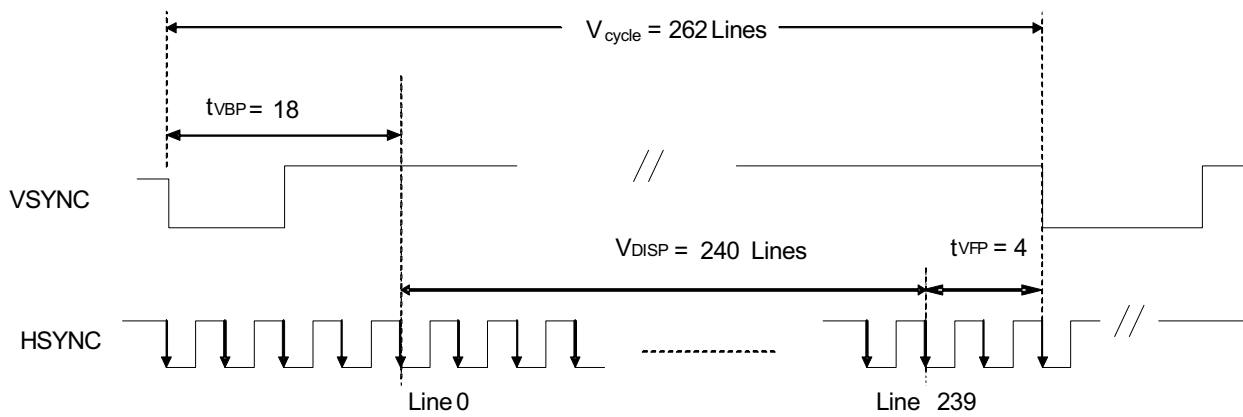
Figure1.2 Data Transaction Timing in Parallel RGB (24 bit) Interface (SYNC Mode)

Characteristics	Symbol	Min-		Typ.		Max.		Unit
		24 bit	8 bit	24 bit	8 bit	24 bit	8 bit	
DOTCLK Frequency	fDOTCLK	-	-	6.5	19.5	10	30	MHz
DOTCLK Period	tDOTCLK	100	33.3	154	51.3	-	-	ns
Horizontal Frequency (Line)	fH	-	-	14.9	-	22.35	-	KHz
Vertical Frequency (Refresh)	fV	-	-	60	-	90	-	Hz
Horizontal Back Porch	tHBP	-	-	68	204	-	-	tDOTCLK
Horizontal Front Porch	tHFP	-	-	20	60	-	-	tDOTCLK
Horizontal Data Start Point	tHBP	-	-	68	204	-	-	tDOTCLK
Horizontal Blanking Period	tHBP + tHFP	-	-	88	264	-	-	tDOTCLK
Horizontal Display Area	HDISP	-	-	320	960	-	-	tDOTCLK
Horizontal Cycle	Hcycle	-	-	408	1224	450	1350	tDOTCLK
Vertical Back Porch	tVBP	-	-	18	-	-	-	Lines
Vertical Front Porch	tVFP	-	-	4	-	-	-	Lines
Vertical Data Start Point	tVBP	-	-	18	-	-	-	Lines
Vertical Blanking Period	tVBP + tVFP	-	-	22	-	-	-	Lines
Vertical Display Area	NTSC	VDISP	-	240	-	-	-	Lines
	PAL			280(PALM=0)				
	PAL			288(PALM=1)				
Vertical Cycle	NTSC	Vcycle	-	262	-	350	-	Lines
	PAL			313				

Table1.2 Data Transaction Timing in Normal Operating Mode

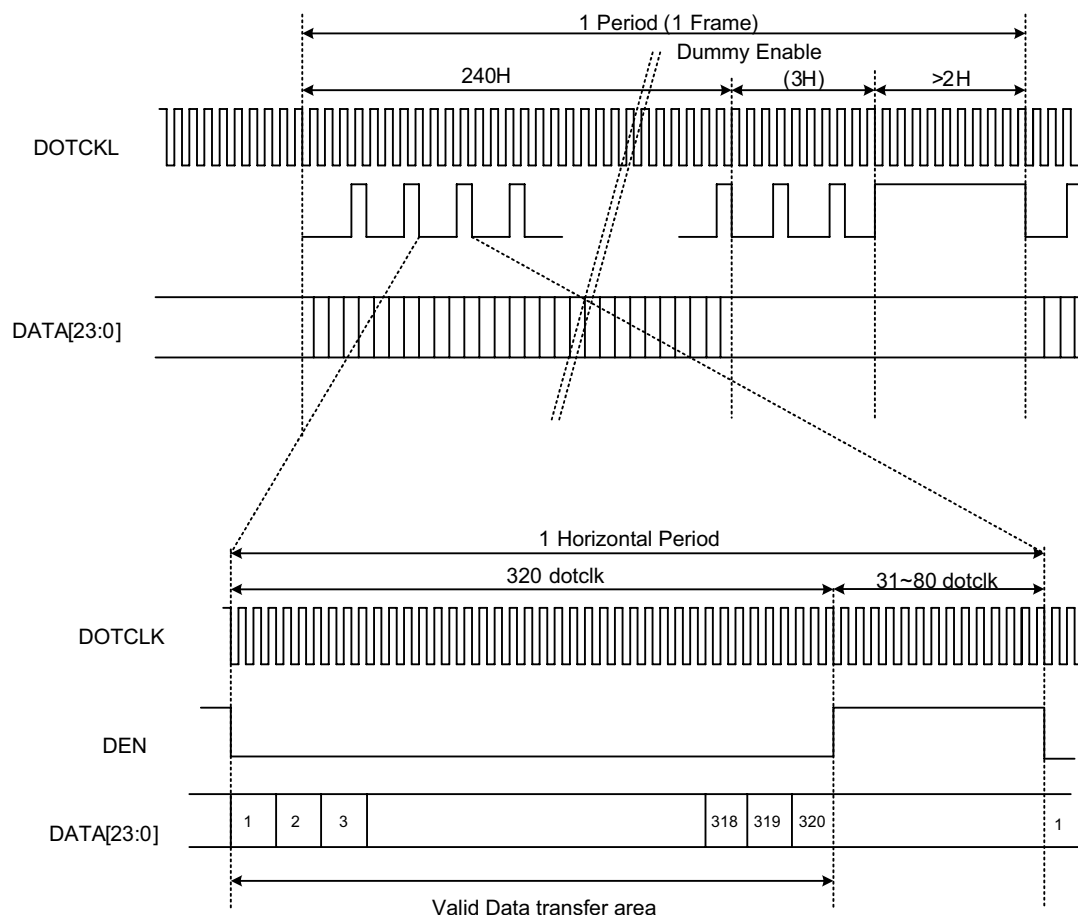


a ) Horizontal Data Transaction Timing

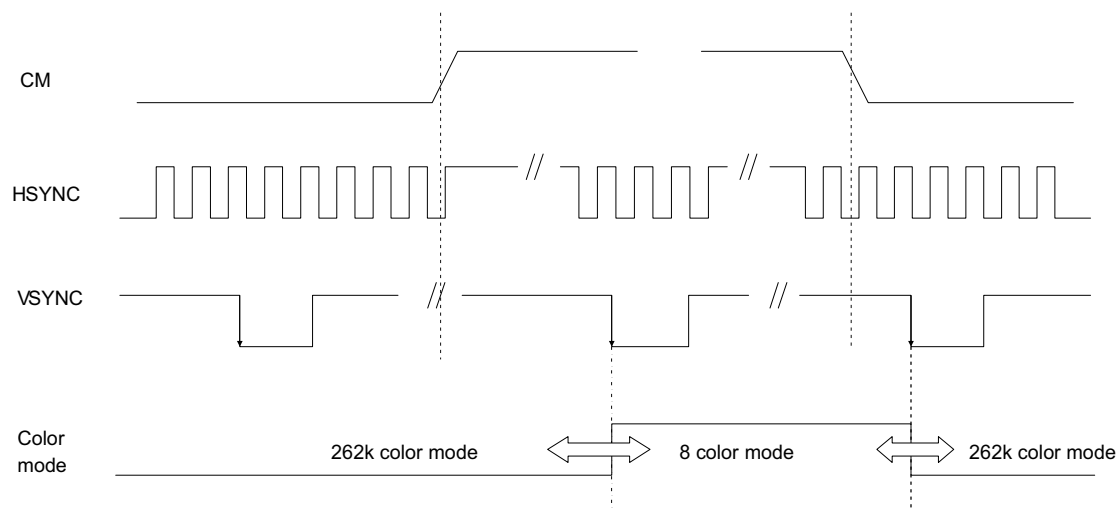


b ) Vertical Data Transaction Timing

**Figure1. 3 Data Transaction Timing in Serial RGB (8 bit) Interface (SYNC Mode)**



**Figure1.4 Signal Timing in DE Mode**



**Note:** The color mode conversion starts at the first falling edge of VSYNC after stage change of CM.

**Figure1.5 Color Mode Conversion Timing**

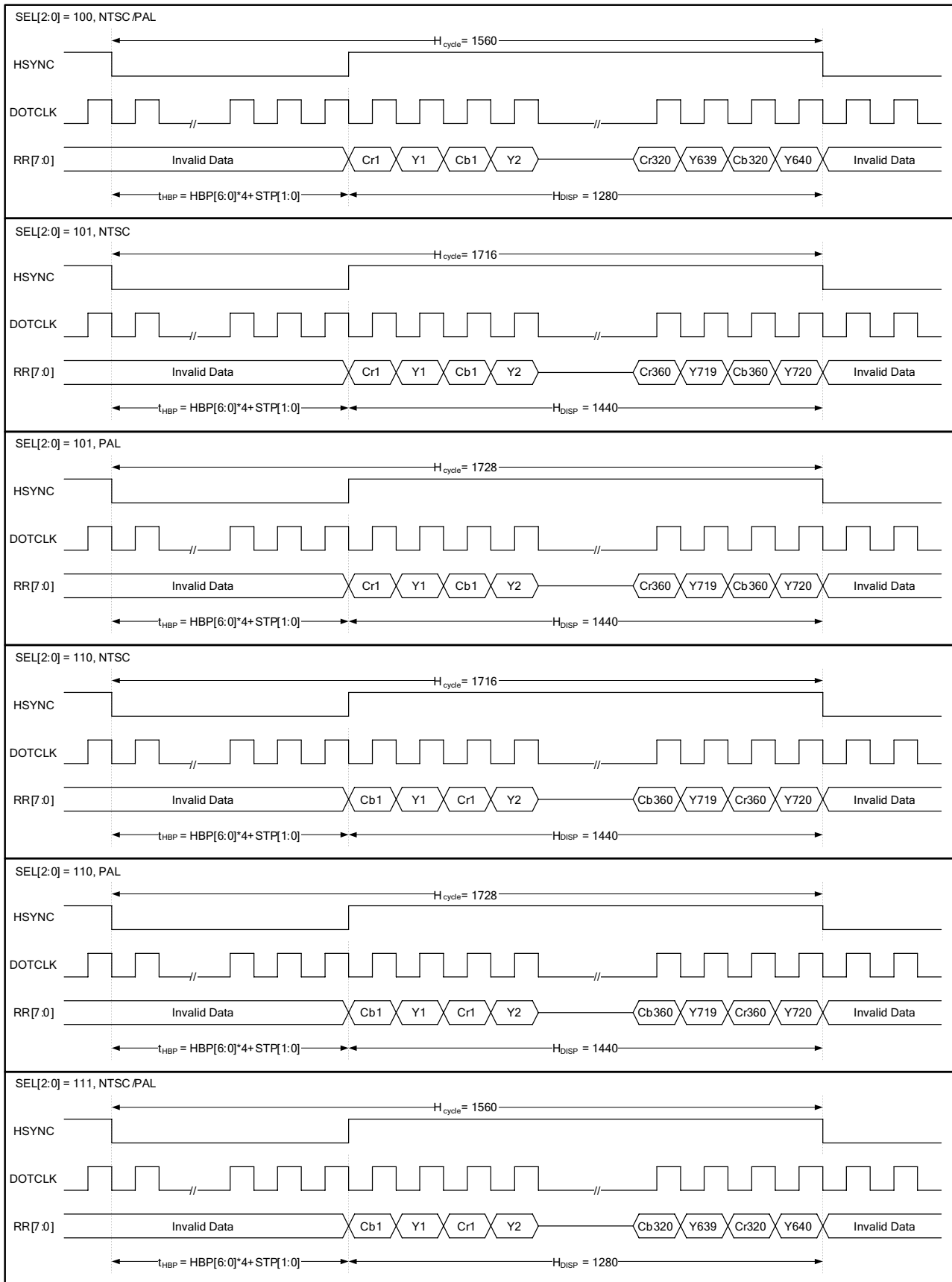


Figure1.6 CCIR601 Horizontal Timing



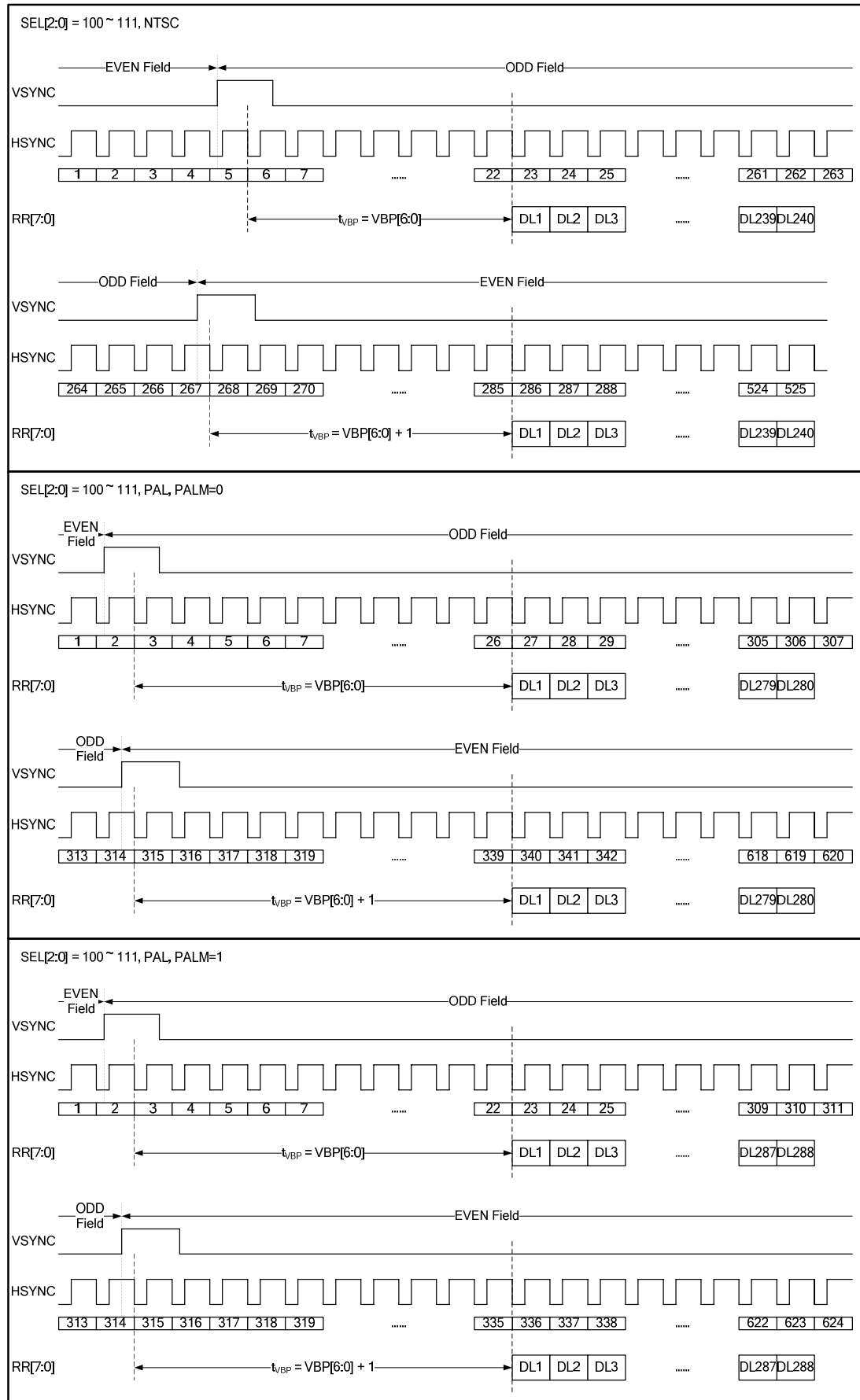


Figure1. 7 CCIR601 Vertical Timing

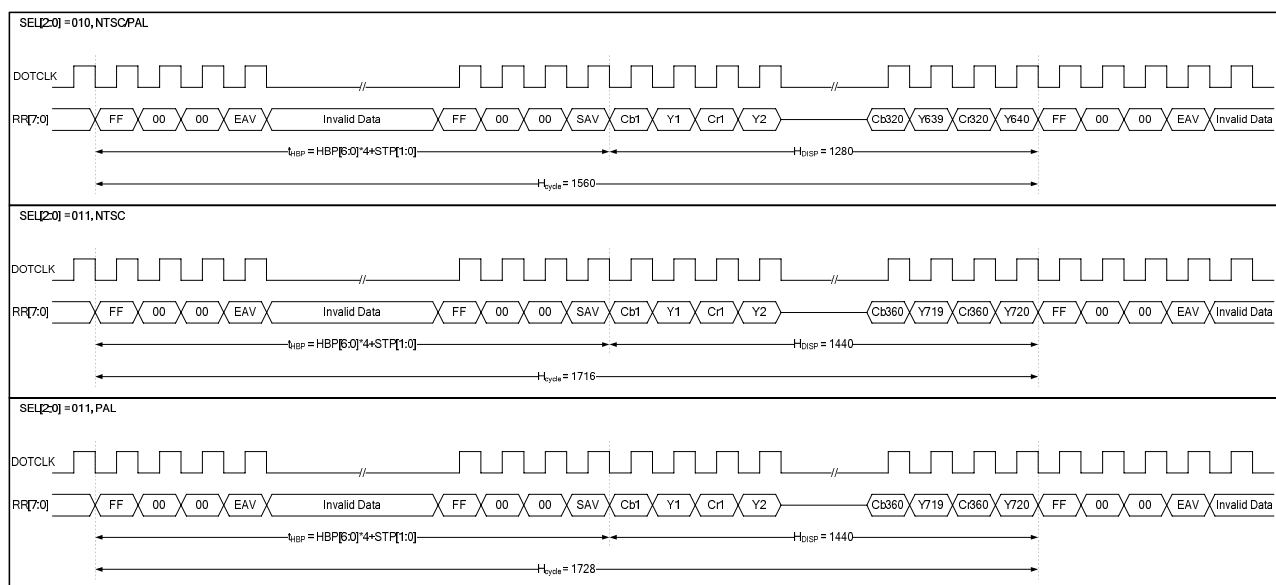


Figure1. 8 CCIR656 Horizontal Timing

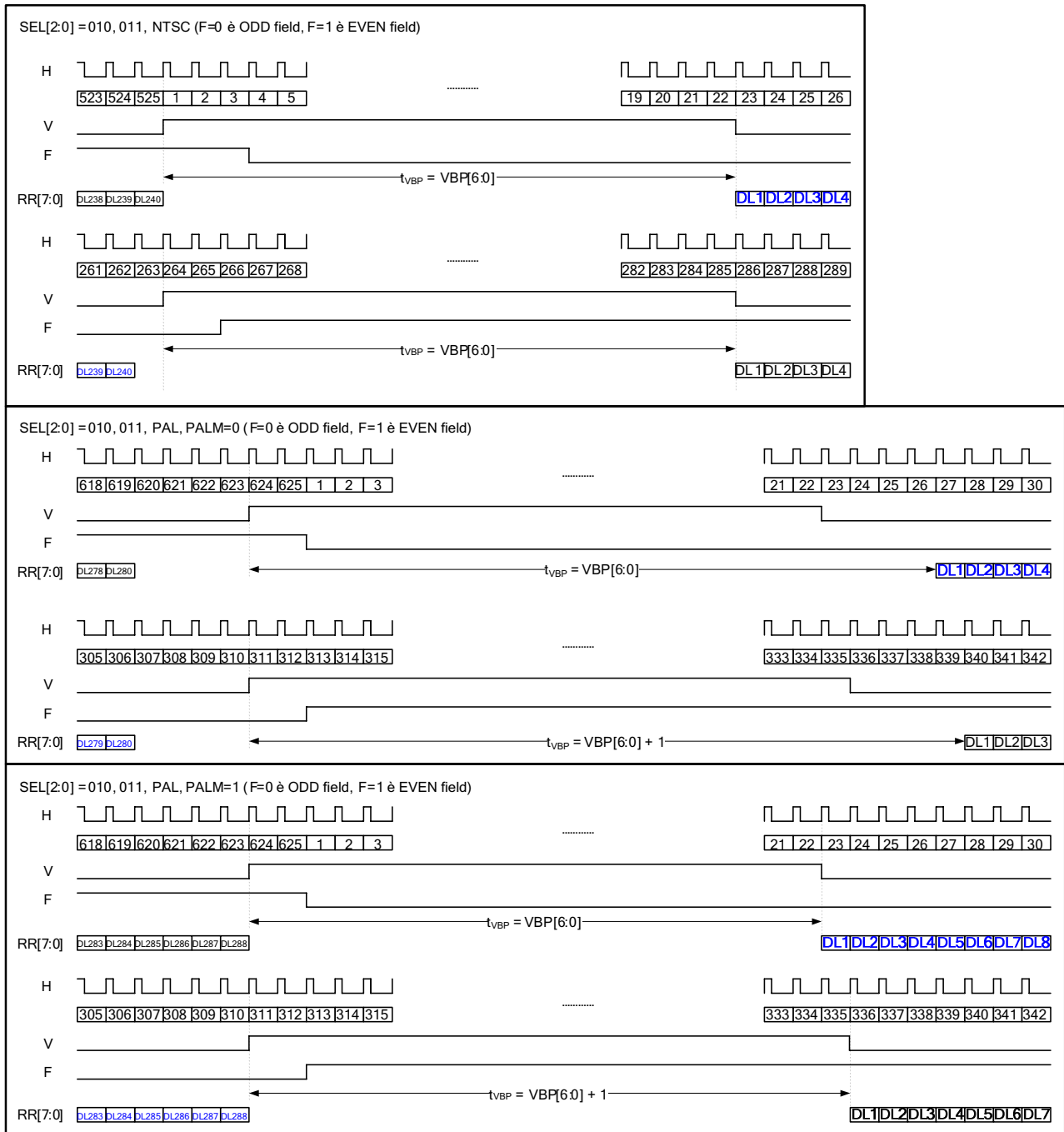


Figure1.9 CCIR656 Vertical Timing

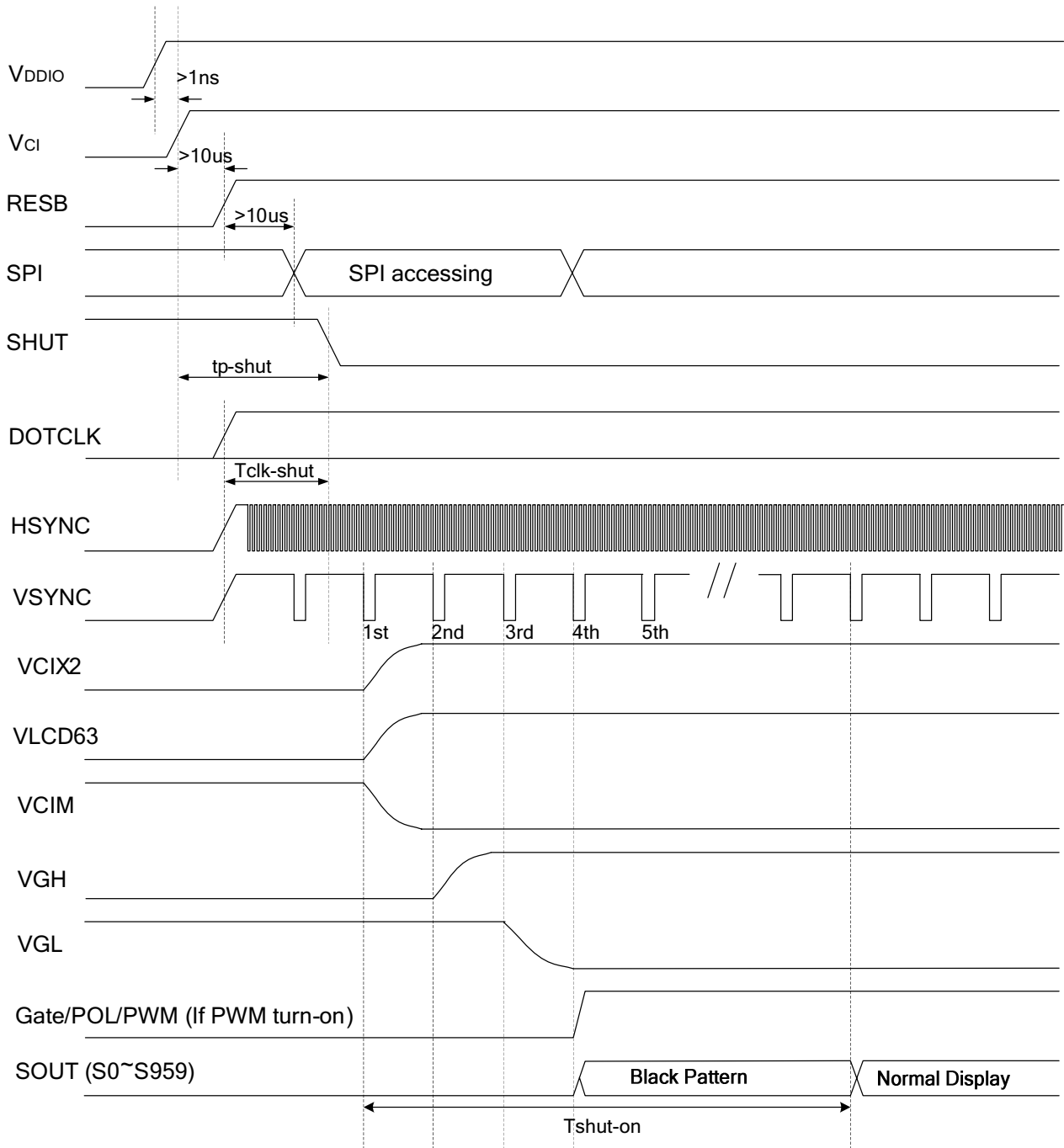


Figure1.10 Power Up Sequence

Characteristics	Symbol	Min.	Typ.	Max.	Unit
VDDD / VDDIO on to falling edge of SHUT	tp-shut	1	-	-	us
DOTCLK	tclk-shut	1	-	-	clk
Falling edge of SHUT to display start	tshut-on	-	-	14	frame
- 1 line: 408 clk - 1 frame: 262 line - DOTCLK = 6.5MHz		-	166	232.4	ms

**Note:** It is necessary to input DOTCLK before the falling edge of SHUT.

Display starts at 10th falling edge of VSTNC after the falling edge of SHUT.

Table1.3 Power Up Sequence

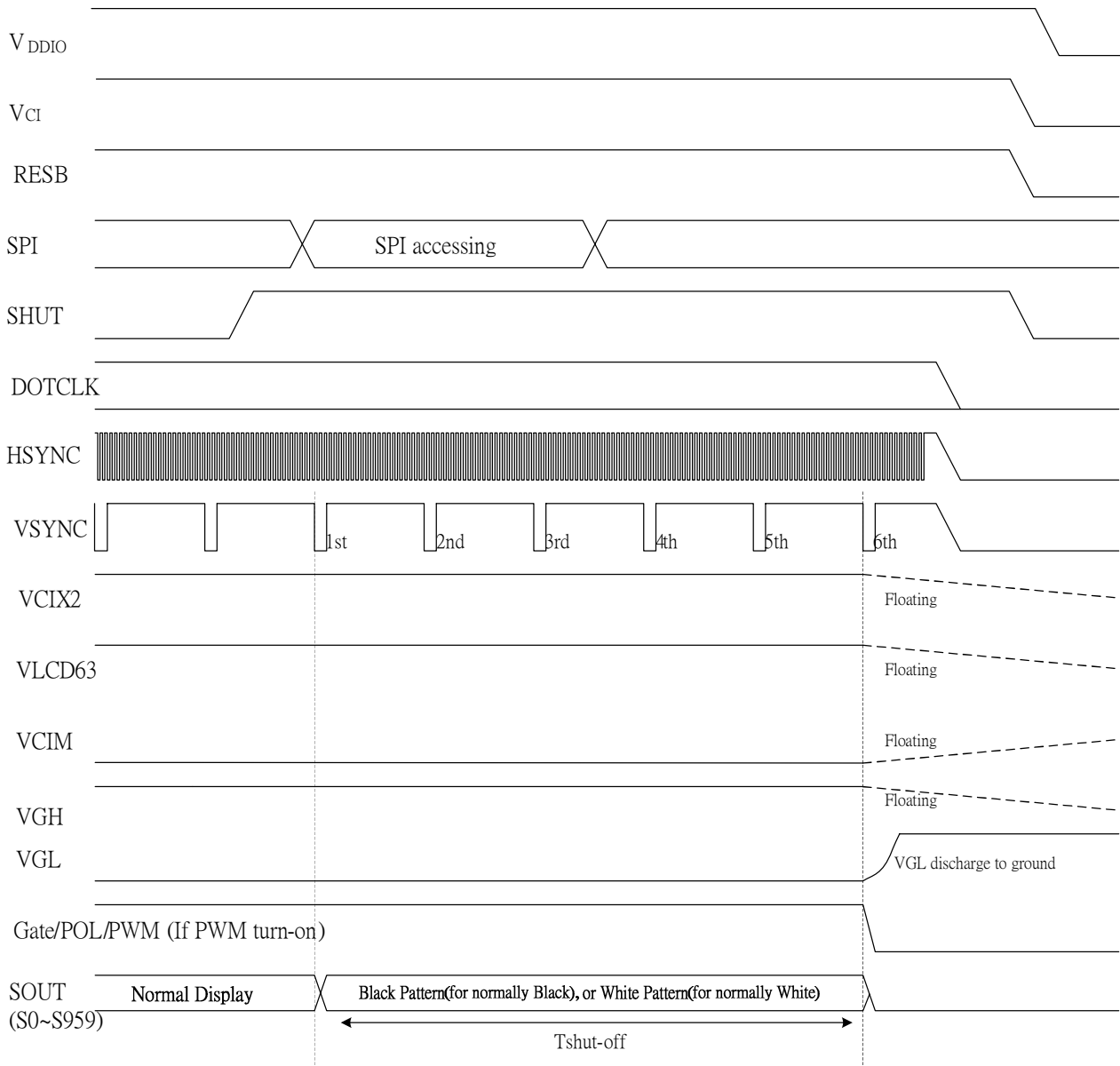


Figure1. 11 Power Down Sequence

Characteristics	Symbol	Min.	Typ.	Max.	Unit
Rising edge of SHUT to display off	tshut-off	2	-	-	frame
- 1 line: 408 clk					
- 1 frame: 262 line		33.4	-	-	ms
- DOTCLK = 6.5MHz					

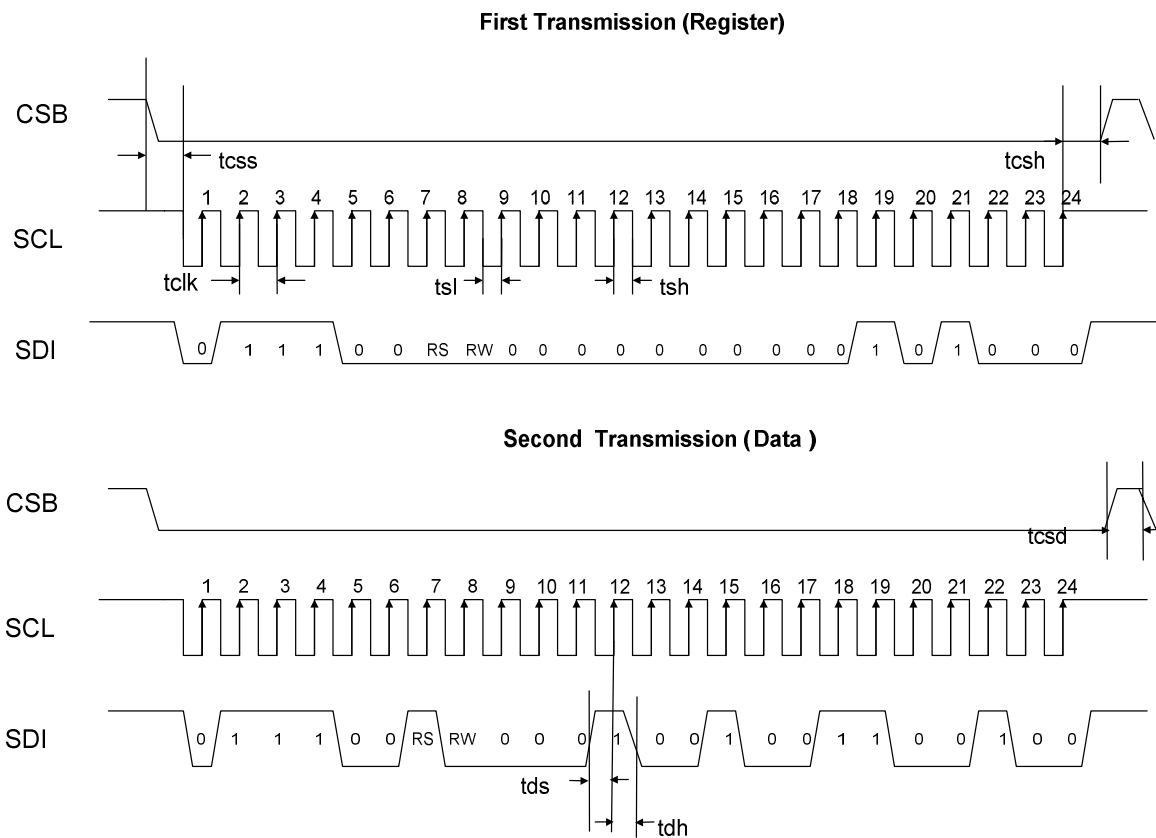
**Note:** DOTCLK must be maintained at least 2 frames after the rising edge of SHUT.

Display become off at the 2nd falling edge of VSTNC after the falling edge of SHUT.

If RESET signal is necessary for power down, provide it after the 2-frames-cycle of the SHUT period.

Table1. 4 Power Down Sequence

- Write SPI



**Note:** The example writes "0x1264h" to register R28h.  
SPID connected to VSS.

**Figure1.12 (a) SPI interface Timing Diagram & Write SPI Example**

## ■ TOUCH PANEL SPECIFICATIONS

### 1. Electrical Characteristics

ITEM	SPECIFICATIONS			UNIT	REMARK
	MIN.	TYP.	MAX.		
Linearity	-1.5	-	1.5	%	After environment & life test
Terminal resistance	400	-	900	ohm	X(Film side)
	200	-	600	ohm	Y(Glass side)
Insulation resistance	20	-	-	Mohm	DC 25V
Operating voltage	-	-	5	VDC	

### 2. Optical Characteristics

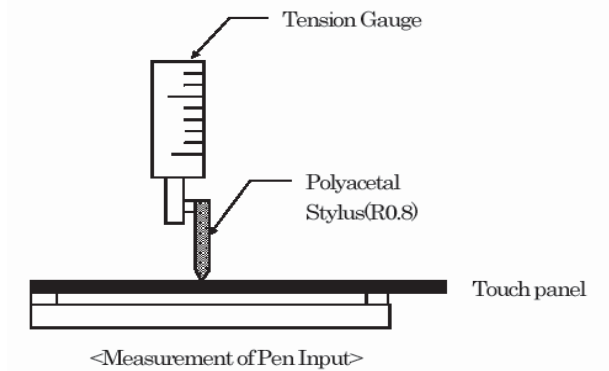
ITEM	SPECIFICATIONS			UNIT	REMARK
	MIN.	TYP.	MAX.		
Response time	-	-	10	ms	100kohm pull-up

### 3. Mechanical Characteristics

ITEM	SPECIFICATIONS			UNIT	REMARK
	MIN.	TYP.	MAX.		
Operation force	-	-	100	gf	Note 1
Surface hardness	3	-	-	H	
Pen sliding durability	100,000	-	-	times	Note 2
Hitting durability	1,000,000	-	-	times	Note 3

Note 1: Active force test condition

- (1) Input DC 5V on X direction, Drop off Polyacetal Stylus (R0.8), until output voltage stabilize ,then get the activation force °
- (2) R8.0mm Silicon rubber for finger Activation force test
- (3) Test point: 9 points



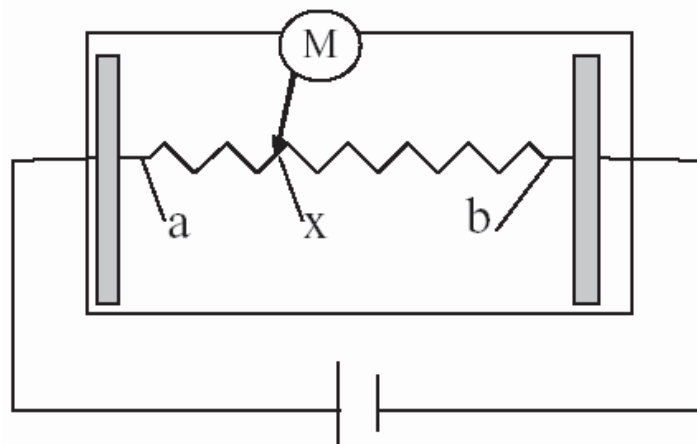
Note 2: Measurement for surface area.

- Scratch 100,000 times straight line on the film with a stylus change every 20,000 times.
- Force: 250gf.
- Speed: 60mm/sec.
- Stylus: R0.8 polyacetal tip.

Note 3: Pit 1,000,000 times on the film with a R0.8 silicon rubber.

- Force: 250gf.
- Speed: 2times/sec.

#### 4. LINEARITY DEFINITION



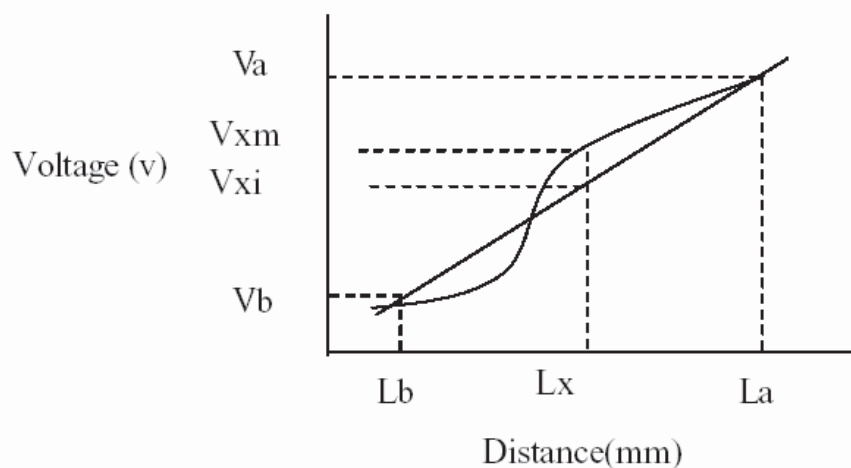
$V_a$ : maximum voltage in the active area of touch panel

$V_b$ : minimum voltage in the active area of touch panel

$X$ : random measuring point

$V_{xm}$ : actual voltage of  $L_x$  point

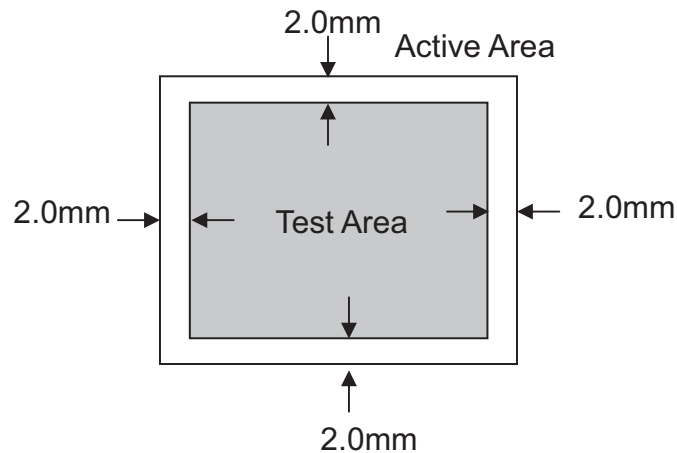
$V_{xi}$ : theoretical voltage of  $L_x$  point





Linearity =  $[|V_{xi} - V_{xm}| / (V_a - V_b)] * 100\%$

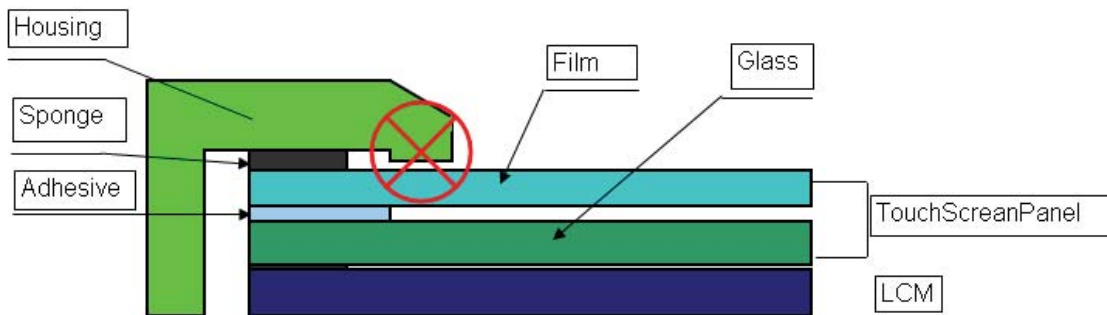
Note: Test area is as follows and operation force is 150gf.



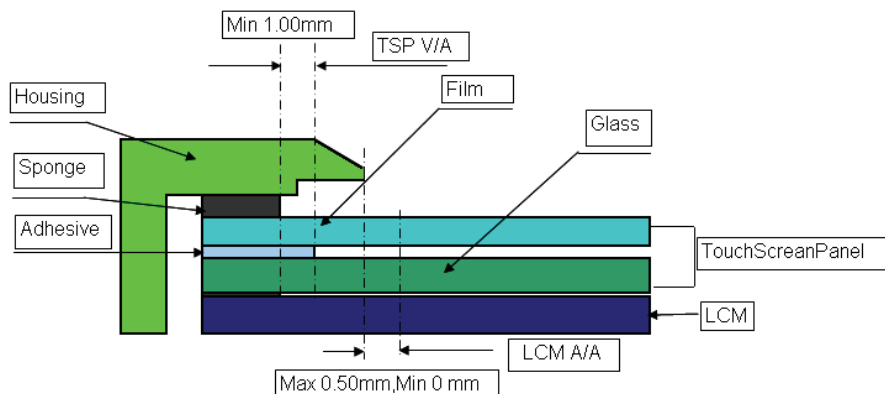
## 5. HOUSING DESIGN GUIDE

Housing design follow as below.

- 1) Avoid the design that housing overlap and press on the active area of the LCM.
- 2) Give enough gap(over 0.5mm at compressed) between the housing and TSP to protect wrong operating.



- 3) Use a buffer material(Gasket) between the TSP and housing to protect damage and wrong operating.  
overlap and press on the inside of TSP view area.



## ■ RELIABILITY TEST

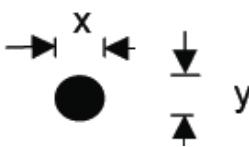
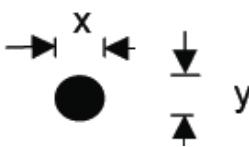
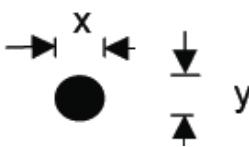
No.	Test Item	Test Condition	Remarks
1	High Temperature Storage Test	T=80°C 120h	Note2
2	Low Temperature Storage Test	T=-30°C 120h	Note1,2
3	High Temperature Operation Test	T=70°C 120h	
4	Low Temperature Operation Test	T=-20°C 120h	Note1
5	High Temperature and High Humidity Operation Test	Ta=40°C,90%RH 120h	Note1,2
6	Thermal Shock Test (Non-operating)	-30°C (30Min)~25°C (5Min)~80°C (30Min) 100Cycles	
7	Vibration Test (Non-operating)	Frequency:10~55Hz Amplitude: 1.5mm Sweep Time: 11Mins Test Period: 6 Cycles For Each Direction Of X,Y,Z	
8	Shock Test (Non-operating)	100G, 6Ms Direction: ±X,±Y, ±Z Cycle: 3Times	
9	Electro Static Discharge Test	Voltage: ±8KV R:330Ω C:150pF Air Discharge, 10 Time.	



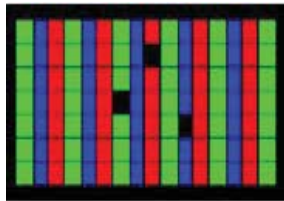
Note 1: Without water condensation

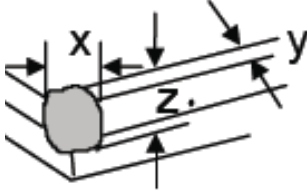
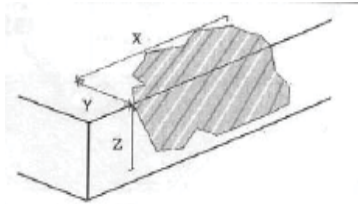
Note 2: The function test shall be conducted after 2 hours storage at the room temperature and humidity after removed from the test chamber.

## ■ INSPECTION CRITERION

OUTGOING QUALITY STANDARD	PAGE 1 OF 5
TITLE:FUNCTIONAL TEST & INSPECTION CRITERIA	
<p>This specification is made to be used as the standard acceptance/rejection criteria for TFT module.</p> <p>1 Sample plan</p> <p>1.1 Lot size: Quantity per shipment lot per model</p> <p>1.2 Sampling type: Normal inspection,Single sampling</p> <p>1.3 Inspection level: II</p> <p>1.4 Sampling table: MIL-STD-105D</p> <p>1.5 Acceptable quality level (AQL)</p> <p>Major defect: AQL=0.65</p> <p>Minor defect: AQL=1.50</p> <p>2. Inspection condition</p> <p>2.1 Ambient conditions:</p> <p>a. Temperature: Room temperature <math>25 \pm 5^{\circ}\text{C}</math></p> <p>b. Humidity: <math>(60 \pm 10) \% \text{RH}</math></p> <p>c. Illumination: Single fluorescent lamp non-directive (300 to 700 Lux)</p> <p>2.2 Viewing distance:</p> <p>The distance between the LCD and the inspector' s eyes shall be at least <math>35 \pm 5 \text{cm}</math>.</p> <p>2.3 Viewing Angle</p> <p>U/D: <math>45^{\circ} / 45^{\circ}</math> , L/R: <math>45^{\circ} / 45^{\circ}</math></p> <div data-bbox="392 1196 911 1480"> </div> <p>3. Definition of Inspection Item.</p> <p>3.1 Definition of inspection zone in LCD.</p> <div data-bbox="384 1592 852 1800"> </div> <p>Zone A: character/Digit area</p> <p>Zone B: viewing area except Zone A (ZoneA+ZoneB=minimum Viewing area)</p> <p>Zone C: Outside viewing area (invisible area after assembly in customer's product)</p> <p>Fig.1 Inspection zones in an LCD.</p>	

OUTGOING QUALITY STANDARD		PAGE 2 OF 5																																	
TITLE:FUNCTIONAL TEST & INSPECTION CRITERIA																																			
<p>Note: As a general rule, visual defects in Zone C are permissible, when it is no trouble for quality and assembly of customer’s product.</p> <p>4. Inspection standards</p> <p>Defects are classified as majot defects and minor defects according to the degree of defectiveness defined herein.</p> <p>4.1 Major defect</p> <table><tr><th>Item No</th><th>Items to be inspected</th><th colspan="2">Inspection Standard</th></tr><tr><td>4.1.1</td><td>All functional defects</td><td colspan="2">1) No display 2) Display abnormally 3) Short circuit 4) Line defect 5) Excess power consumption</td></tr><tr><td>4.1.2</td><td>Missing</td><td colspan="2">Missing function component</td></tr><tr><td>4.1.3</td><td>Crack</td><td colspan="2">Glass crack</td></tr></table> <p>4.2 Minor defect</p> <table><tr><th>Item No</th><th>Items to be inspected</th><th colspan="2">Inspection standard</th></tr><tr><td rowspan="5">4.2.1</td><td rowspan="5">Spot Defect Including Black spot White spot Pinhole Foreign particle Polarizer dirt</td><td colspan="2">For dark/white spot is defined <math display="block">\varphi = (x + y) / 2</math></td></tr><tr><td>Size <math>\varphi(\text{mm})</math></td><td>Acceptable Quantity</td></tr><tr><td><math>\varphi \leq 0.15</math> 2mm(min) apart</td><td>Ignore</td></tr><tr><td><math>0.15 &lt; \varphi \leq 0.25</math> 5mm(min) apart</td><td>3</td></tr><tr><td><math>0.25 &lt; \varphi</math></td><td>Not allowed</td></tr></table>				Item No	Items to be inspected	Inspection Standard		4.1.1	All functional defects	1) No display 2) Display abnormally 3) Short circuit 4) Line defect 5) Excess power consumption		4.1.2	Missing	Missing function component		4.1.3	Crack	Glass crack		Item No	Items to be inspected	Inspection standard		4.2.1	Spot Defect Including Black spot White spot Pinhole Foreign particle Polarizer dirt	For dark/white spot is defined $\varphi = (x + y) / 2$ 		Size $\varphi(\text{mm})$	Acceptable Quantity	$\varphi \leq 0.15$ 2mm(min) apart	Ignore	$0.15 < \varphi \leq 0.25$ 5mm(min) apart	3	$0.25 < \varphi$	Not allowed
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OUTGOING QUALITY STANDARD			PAGE 3 OF 5	
TITLE:FUNCTIONAL TEST & INSPECTION CRITERIA				
4.2.2	Line Defect Including Black line White line Scratch	Define: 		
		Width(mm) Length(mm)	Acceptable Quantity	
		W≤0.05 and L≤10	Ignore	
		0.05 < W≤0.08 and L≤10 3mm(min) apart	3	
		0.08 < W≤0.10 and L≤5 3mm(min) apart	1	
		0.10 < W or 10 < L	Not allowed	
4.2.3	Polarizer Dent/Bubble	Size ϕ(mm)	Acceptable Quantity	
		ϕ≤0.25	Ignore	
		Non visible area	Ignore	
		0.25 < ϕ≤0.40 5mm(min) apart	2	
		0.40 < ϕ	Not allowed	
4.2.4	Electrical Dot Defect	Bright and Black dot define:  and 		
		Inspection pattern: Full white, Full black, Red, green and blue screens		
		Item	Acceptable Quantity	
		Black dot defect	2	
		Bright dot defect	0	
		Total Dot	2	

OUTGOING QUALITY STANDARD		PAGE 4 OF 5	
TITLE:FUNCTIONAL TEST & INSPECTION CRITERIA			
4.2.5	Touch panel chips	 <p>1. Corner chips:</p>	
		Size(mm)	Acceptable Quantity
		$X \leq 3\text{mm}$ $Y \leq 3\text{mm}$ $Z \leq T$	Ignore T: Glass thickness X: Length Y: Width Z: thickness
		 <p>2. Side chips:</p>	
		Size(mm)	Acceptable Quantity
		$X \leq 5\text{mm}$ $Y \leq 3\text{mm}$ $Z \leq T$	Ignore T: Glass thickness X: Length Y: Width Z: thickness

OUTGOING QUALITY STANDARD	PAGE 5 OF 5
TITLE:FUNCTIONAL TEST & INSPECTION CRITERIA	
<p>Note:</p> <ol style="list-style-type: none"><li>1. Dot defect is defined as the defective area of the dot area is larger than 50% of the dot area.</li><li>2. The distance between black dot defects or black and bright dot defects should be more than 5mm apart. The distance between two bright dot defects should be more than 15mm apart</li><li>3. Polarizer bubble is defined as the bubble appears on active display area. The defect of polarizer bubble shall be ignored if the polarizer bubble appears on the outside of active display area.</li><li>4. Mura is checker by 6% ND filter.</li><li>5. Foreign particle on the surface of the LCM should be ignore.</li></ol>	

## ■ PRECAUTIONS FOR USING LCD MODULES

### Handling Precautions

(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.

(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.

(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).

(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 polarizers 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. 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 is contacting with room temperature air.

(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

- Isopropyl alcohol
- Ethyl alcohol

Do not scrub hard to avoid damaging the display surface.

(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 contacting oil and fats.

(7) Exercise care to minimize corrosion of the electrode. Corrosion of the electrodes is accelerated by water droplets, moisture condensation or a current flow in a high-humidity environment.

(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.

(9) Do not attempt to disassemble or process the LCD module.

(10) NC terminal should be open. Do not connect anything.

(11) If the logic circuit power is off, do not apply the input signals.

(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.

- Before remove LCM from its packing case or incorporating it into a set, be sure the module and your body have the same electric potential. Be sure to ground the body when handling the LCD modules.

- Tools required for assembling, such as soldering irons, must be properly grounded. make certain the AC power source for the soldering iron does not leak. When using an electric screwdriver to attach LCM, the screwdriver should be of ground potentiality to minimize as much as possible any transmission of electromagnetic waves produced sparks coming from the commutator of the motor.

- To reduce the amount of static electricity generated, do not conduct assembling and other work under dry conditions. To reduce the generation of static electricity be careful that the air in the work is not too dried. A relative humidity of 50%-60% is recommended. As far as possible make the electric potential of your work clothes and that of the work bench the ground potential

- The LCD module is coated with a film to protect the display surface. Exercise care when peeling off this protective film since static electricity may be generated



(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.

- Do not alter, modify or change the shape of the tab on the metal frame.
- Do not make extra holes on the printed circuit board, modify its shape or change the positions of components to be attached.
- Do not damage or modify the pattern writing on the printed circuit board.
- Absolutely do not modify the zebra rubber strip (conductive rubber) or heat seal connector.
- Except for soldering the interface, do not make any alterations or modifications with a soldering iron.
- Do not drop, bend or twist LCM.

#### Handling precaution for LCM

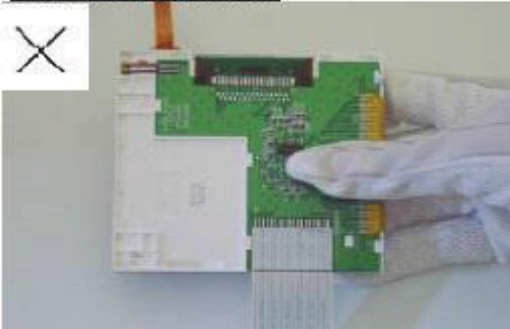
LCM is easy to be damaged.  
Please note below and be careful for handling!

##### **Correct handling:**

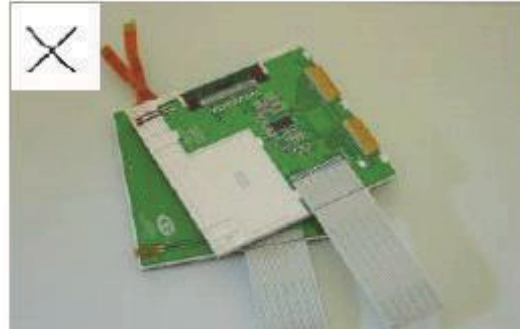


As above picture, please handle with anti-static gloves around LCM edges.

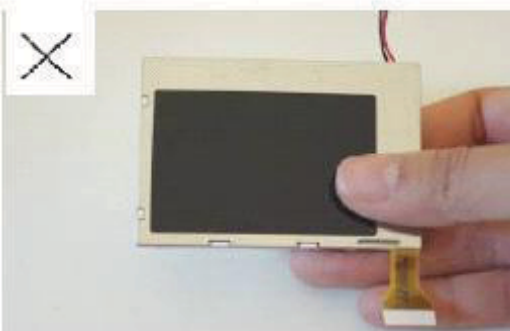
##### **Incorrect handling:**



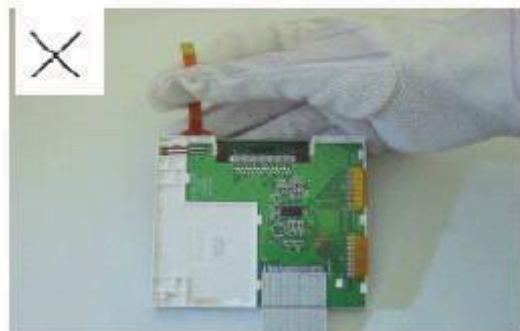
Please don't touch IC directly.



Please don't stack LCM.



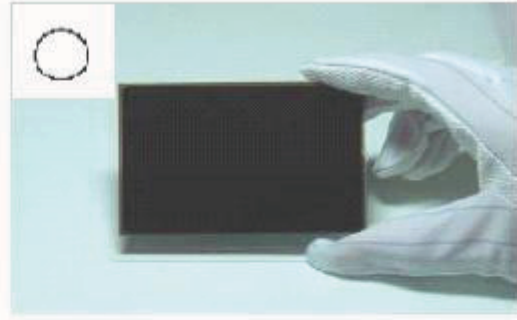
Please don't hold the surface of panel.



Please don't stretch interface of output, such as FPC cable.

**Handling precaution for LCD**

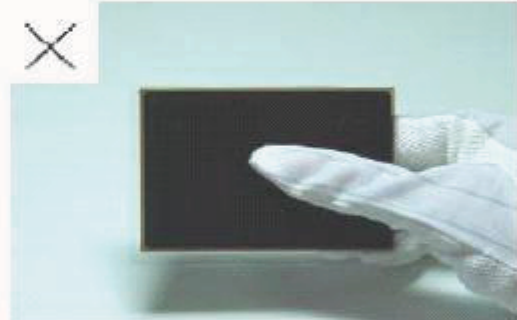
LCD is easy to be damaged.  
Please note below and be careful for handling!

**Correct handling:**

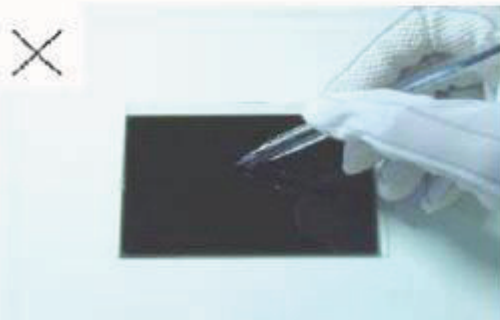
As above photo, please handle with anti-static gloves around LCD edges.

**Incorrect handling:**

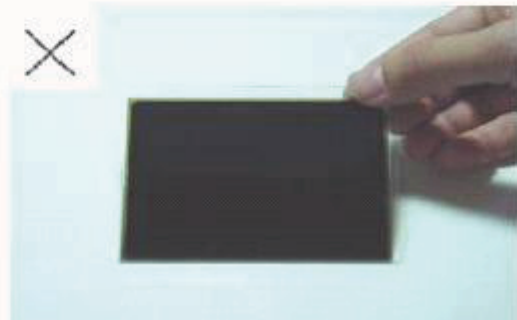
Please don't stack the LCDS.



Please don't hold the surface of LCD.



Please don't operate with sharp stick such as pens.



Please don't touch ITO glass without anti-static gloves.

## Storage Precautions

When storing the LCD modules, the following precaution is necessary.

- (1) Store them in a sealed polyethylene bag. If properly sealed, there is no need for the dessicant.
- (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.
- (3) The polarizer surface should not come in contact with any other objects. (We advise you to store them in the anti-static electricity container in which they were shipped.

### Others

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.

If the LCD modules have been operating for a long time showing the same display patterns, the display patterns may remain on the 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.

To minimize the performance degradation of the LCD modules resulting from destruction caused by static electricity etc., exercise care to avoid holding the following sections when handling the modules.

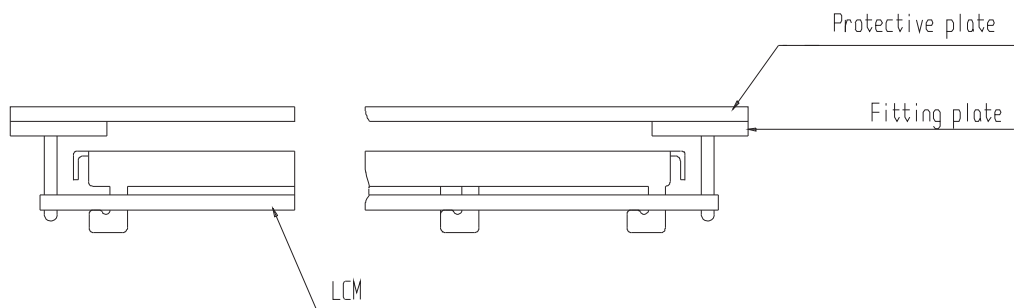
- Exposed area of the printed circuit board.
- Terminal electrode sections.

## USING LCD MODULES

### Installing LCD Modules

The hole in the printed circuit board is used to fix LCM as shown in the picture below. Attend to the following items when installing the LCM.

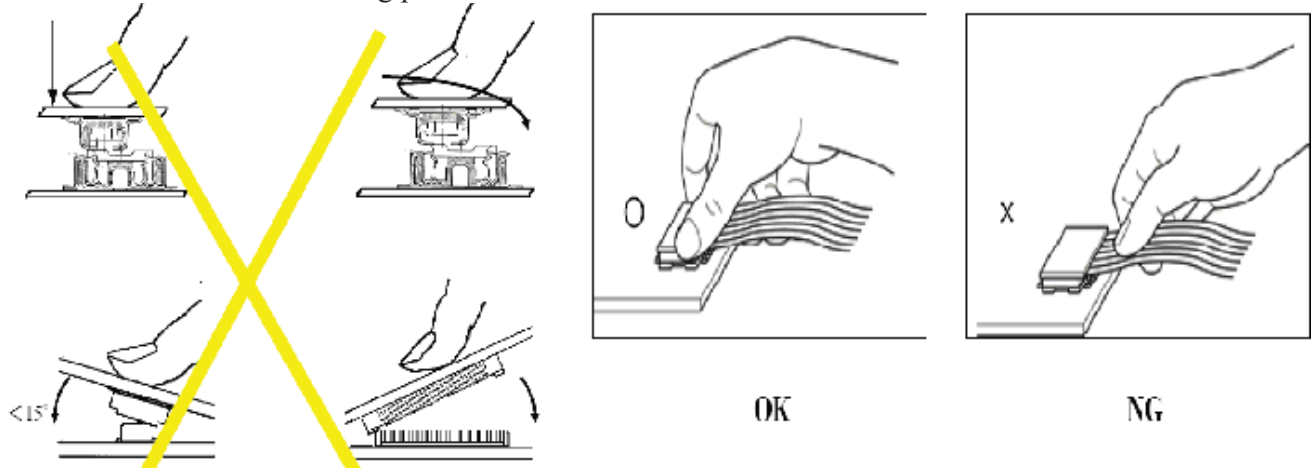
- (1) Cover the surface with a transparent protective plate to protect the polarizer and LC cell.



- (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  $\pm 0.1\text{mm}$ .

### Precaution for assemble the module with BTB connector:

Please note the position of the male and female connector position, don't assemble or assemble like the method which the following picture shows



**Precaution for soldering to the LCM**

	Hand soldering	Machine drag soldering	Machine press soldering
No ROHS product	290°C ~350°C. Time : 3-5S.	330°C ~350°C. Speed : 4-8 mm/s.	300°C ~330°C. Time : 3-6S. Press: 0.8~1.2Mpa
ROHS product	340°C ~370°C. Time : 3-5S.	350°C ~370°C. Time : 4-8 mm/s.	330°C ~360°C. Time : 3-6S. Press: 0.8~1.2Mpa

(1) 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.

(2) 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.

(3) 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.

**Precautions for Operation**

(1) Viewing angle varies with the change of liquid crystal driving voltage (VLCD). Adjust VLCD to show the best contrast.

(2) It is an indispensable condition to drive LCD's within the specified voltage limit since the higher voltage then the limit cause the shorter LCD life. An electrochemical reaction due to direct current causes LCD's undesirable deterioration, so that the use of direct current drive should be avoided.

(3) Response time will be extremely delayed at lower temperature than the operating temperature range and on the other hand at higher temperature LCD's show dark color in them. However those phenomena do not mean malfunction or out of order with LCD's, Which will come back in the specified operating temperature.

(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 then back on.

(5) A 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.

(6) Input each signal after the positive/negative voltage becomes stable.

(7) Please keep the temperature within specified range for use and storage. Polarization degradation, bubble generation or polarizer peel-off may occur with high temperature and high humidity.

**Safety**

(1) It is recommended to crush damaged or unnecessary LCDs into pieces and wash them off with solvents such as acetone and ethanol, which should later be burned.

(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.

**Safety**

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**Limited Warranty**

Unless agreed otherwise between Display Future Ltd and customer, Display Future will replace or repair any of its LCD modules which are found to be functionally defective when inspected in accordance with LCD acceptance standards (copies available upon request) for a period of one year from date of production. Cosmetic/visual defects must be returned within 90 days of the shipment. Confirmation of such date shall be based on data code on the product.

The warranty liability of Display Future limited to repair and/or replacement on the terms set forth above. Display Future will not be responsible for any subsequent or consequential events.

**Return LCM under warranty**

No warranty can be granted if the precautions stated above have been disregarded. The typical examples of violations are :

- Broken LCD glass.
- PCB eyelet is damaged or modified.
- PCB conductors damaged.
- Circuit modified in any way, including addition of components.
- PCB tampered with by grinding, engraving or painting varnish.
- Soldering to or modifying the bezel in any manner.

Module repairs will be invoiced to the customer upon mutual agreement. Modules must be returned with sufficient description of the failures or defects. Any connectors or cable installed by the customer must be removed completely without damaging the PCB eyelet, conductors and terminals.

**■ PRIOR CONSULT MATTER**

- 1.①For Display Future standard products, we keep the right to change material and processes for improving the product, without notice to our customers.  
②For OEM products, if any change is needed, which may affect the product property, we will consult with our customer in advance.
2. If you have special requirement about reliability condition, please let us know before you start the test on our samples.