ORIENT DISPLAY

Your Total LCD Solution Provider

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SPECIFICATION
FOR
LCD MODULE

MODULE NO: AFS320240TG-5.7-A000001
REVISION NO: 00

Customer's Approval:

	SIGNATURE	DATE
PREPARED BY (RD ENGINEER)	Fr. Li	Sep-10-2011
CHECKED BY	Ylh	Sep-10-2011
APPROVED BY	Sean	Sep-10-2011

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DOCUMENT REVISION HISTORY

Version	DATE	DESCRIPTION	CHANGED BY
00	Sep-10-2011	First Issue	Fr.li

CONTENTS

1. Features & Mechanical Specifications

Item	Contents	Unit
	LCD	
LCD Type	TFT / Transmissive / Normally White	--
Viewing direction	12 O'clock	--
Backlight	White LED x 20	--
Interface	RGB interface	--
Driver IC	HX8218-C01 + HX8615C	--
Outline Dimension	125.4(W) × 102.0(H) × 6.0(T)	mm
Glass area (W×H×T)	120.28 × 90.64 / 95.74 × 1.0	mm
Active area (W×H)	115.2 × 86.4	mm
Number of Dots	320(RGB)×240	--
Dot pitch (W×H)	0.36 × 0.36	mm
Pixel pitch (W×H)	0.12 × 0.36	mm
Operating Temperature	-10 ～ +60	℃
Storage temperature	-20 ～ +70	℃

2. Dimensional Outline

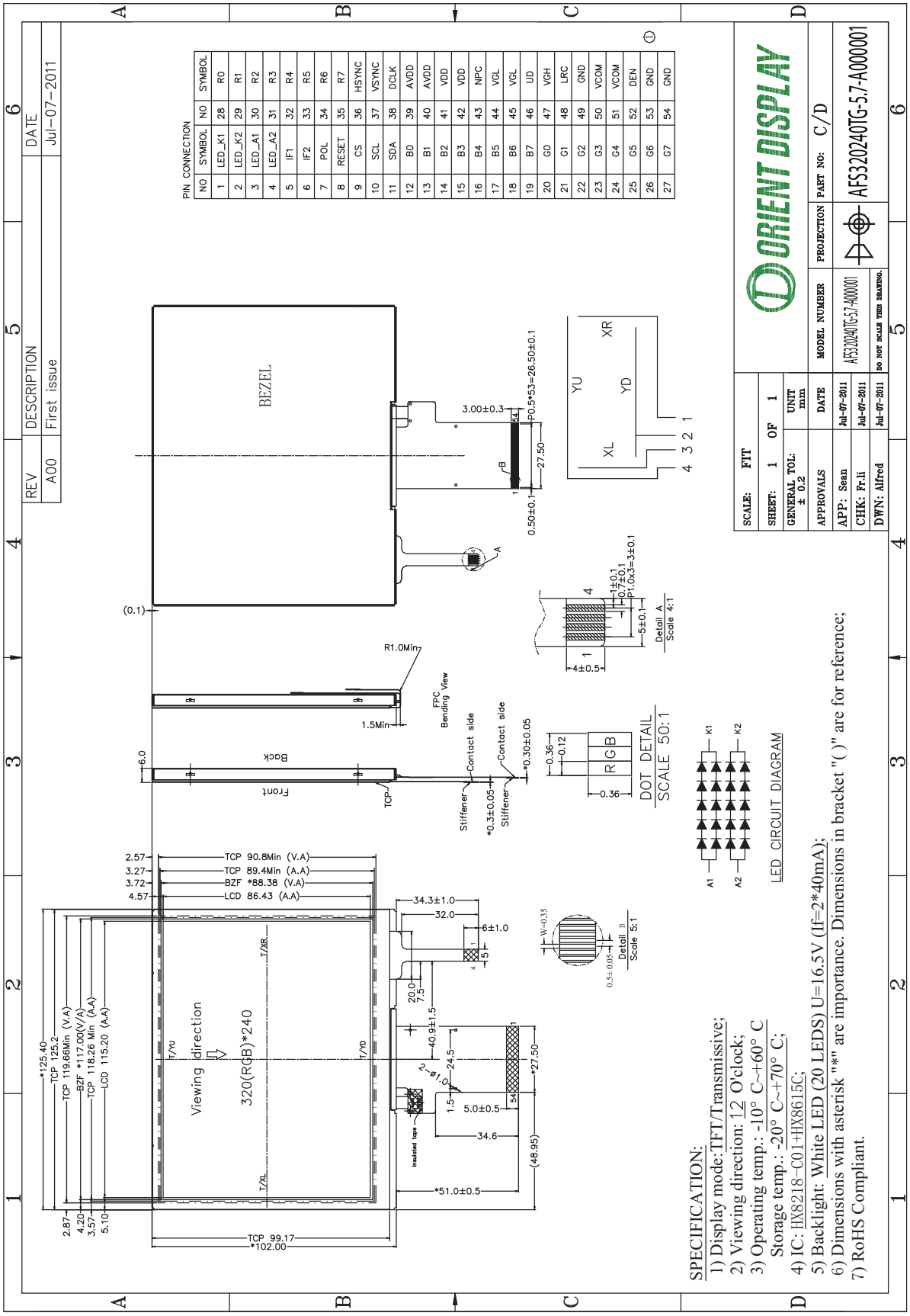


Figure 1. Dimensional outline

3. Pin Description

PIN No.	SYMBOL	Function
1	LEDK1	LED Backlight Cathode
2	LEDK2	LED Backlight Cathode
3	LEDA1	Back-light LED Anode
4	LEDA2	Back-light LED Anode
5	IF1	Control the input data format. NOTE (1)
6	IF2	
7	POL	Polarity select for the line inversion control signal. NOTE (2) When POL=L, output voltage is negative polarity. When POL=H, output voltage is positive polarity.
8	RESET	Reset Signal (Low Active, 10us at least).
9	CS	Serial Interface Chip Select.
10	SCL	Serial Interface Clock.
11	SDA	Serial Interface Data.
12~19	B0~B7	Blue Data Input. NOTE (3)
20~27	G0~G7	Green Data Input. NOTE (3)
28~35	R0~R7	Red Data Input. NOTE (3)
36	HSYNC	Horizontal sync input in digital RGB mode. Or HREF input in CCIR601 mode.(Short to GND if not used)
37	VSYNC	Vertical sync input in digital RGB mode. Or V123 input in CCIR601 mode.(Short to GND if not used)
38	DCLK	Data Clock.
39-40	AVDD	Analog Power (+5.0V)
41-42	VDD	Digital Power (+3.3V)
43	NPC	NTSC or PAL mode auto detection result When NPC=H, NTSC mode is selected. When NPC=L, PAL mode is selected.
44-45	VGL	Gate Off Power (-10.0V)
46	UD	Up/down scan setting. When UD=H, reverse scan. When UD=L, normal scan.
47	VGH	Gate On Power (+15.0V)
48	LRC	This pin controls the output shifting direction as listed below. LRC=H: STH OUT1 • • • OUT960 STHO LRC=L: STH OUT960 • • • OUT1 STHO
49	GND	Ground
50-51	VCOM	Vcom Driving Input NOTE (2)
52	DEN	Data Enable signal
53-54	GND	Ground

NOTE:
(1) Input data format.

IF1	IF2	Input data format
L	L	Serial RGB
H	L	Parallel RGB
L	H	CCIR601
H	H	CCIR656

(2)The polarity of VCOM (Pin 50,51) should be generated from POL (Pin 7)
(3) In serial RGB or CCIR601/656 input mode, only R0~R7 are used, and others are to connect to GND.

4. Absolute Maximum Ratings

Item	Symbol	Rating	Unit
Power Supply Voltage	VDD	-0.3 to +7.0	V
Input Voltage	AVDD	-0.3 to +7.0	
Operating Temperature range	TOP	-10 to +60	℃
Storage Temperature range	TST	-20 to +70	℃

5. Electrical Characteristics

DC Characteristics

Item	Symbol	Min.	Type.	Max.	Unit
Power Supply Voltage	VDD	3	3.3	3.6	V
Power Supply Voltage	AVDD	3.8	5	5.5	

6. Backlight Characteristics

(White LED × 5 in series) ×4 in Parallel **(Ta = 25°C)**

Item	Symbol	Condition	Min	Typ	Max	Unit
Forward Voltage	VF	IF=2 * 40mA	-	16.5	-	V
Uniformity	△Bp	-	80	-	-	%
Luminance for LCD	Lv	IF=2 * 40mA	4000	-	-	cd/m^2

7. Electro-Optical Characteristics

light source: C light,using CMO TN LC+Polarizer,reference only)

Item		Symbol	Conditions	Specifications Min.	Typ.	Max.	Unit	Note
Transmittance		T%	Viewing normal angle $\theta_X = \theta_Y = 0°$		8.1		%	All left side data are based on CMO's following condition – NTSC: 58% LC: CMO LC Light : C light (Machine:BM5A) Polarizer without DBEF **Reference Only**
Contrast Ratio		CR		150	250	-	--	
Response Time		T_R		-	15	30	ms	
		T_F		-	35	50	ms	
Chromaticity	Red	X_R		0.610	0.640	0.670		
		Y_R		0.314	0.344	0.374		
	Green	X_G		0.268	0.298	0.328		
		Y_G		0.553	0.583	0.613		
	Blue	X_B		0.102	0.132	0.162		
		Y_B		0.107	0.137	0.167		
	White	X_W		0.282	0.312	0.342		
		Y_W		0.319	0.349	0.379		
Viewing Angle	Hor.	θ_{X+}	Center CR≥10	-	45		deg.	
		θ_{X-}		-	45			
	Ver.	θ_{Y+}		-	15			
		θ_{Y-}		-	35			

*Note (1) Definition of Contrast Ratio (CR):

The contrast ratio can be calculated by the following expression.

Contrast Ratio (CR) = L63 / L0

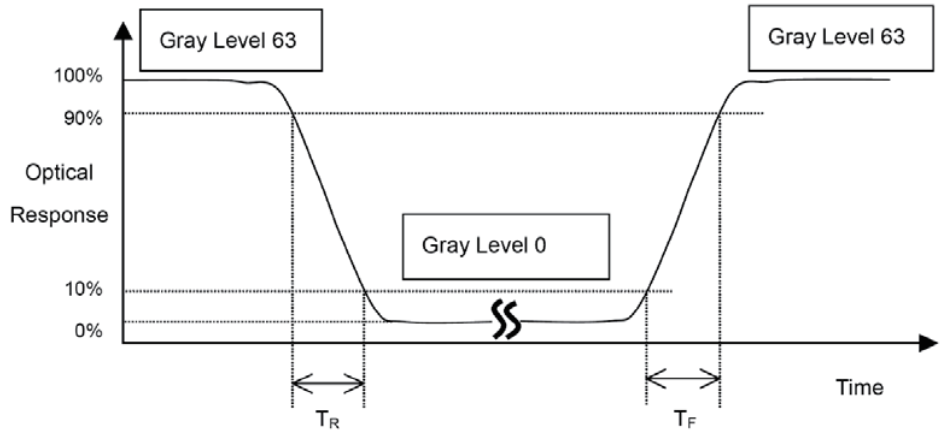
L63: Luminance of gray level 63

L0: Luminance of gray level 0

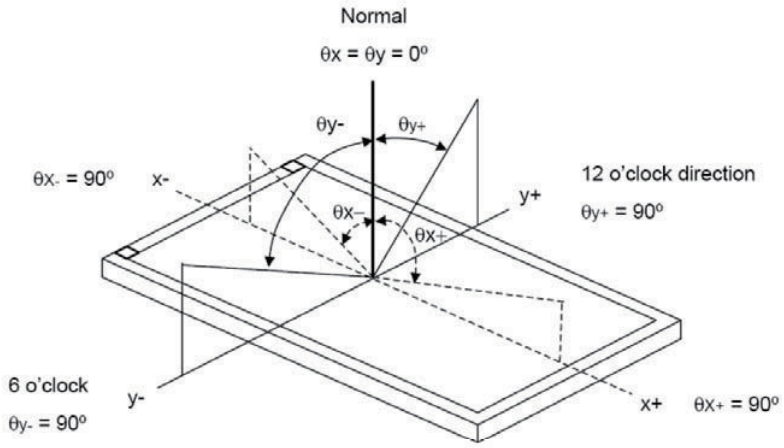
CR = CR (5)

CR (X) is corresponding to the Contrast Ratio of the point X at Figure in Note (5).

*Note (2) Definition of Response Time (TR, TF):



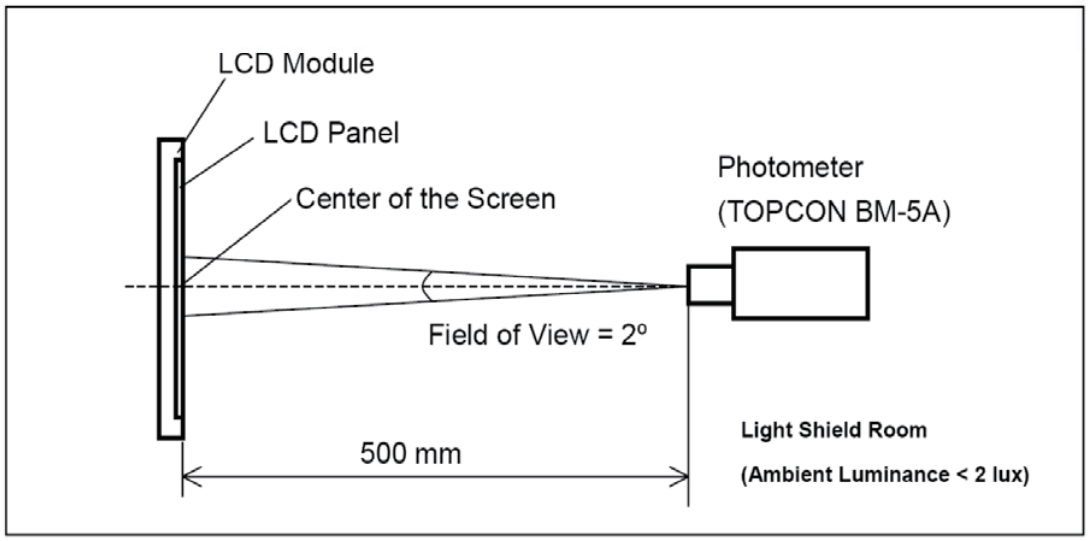
*Note(3) Definition of Viewing Angle



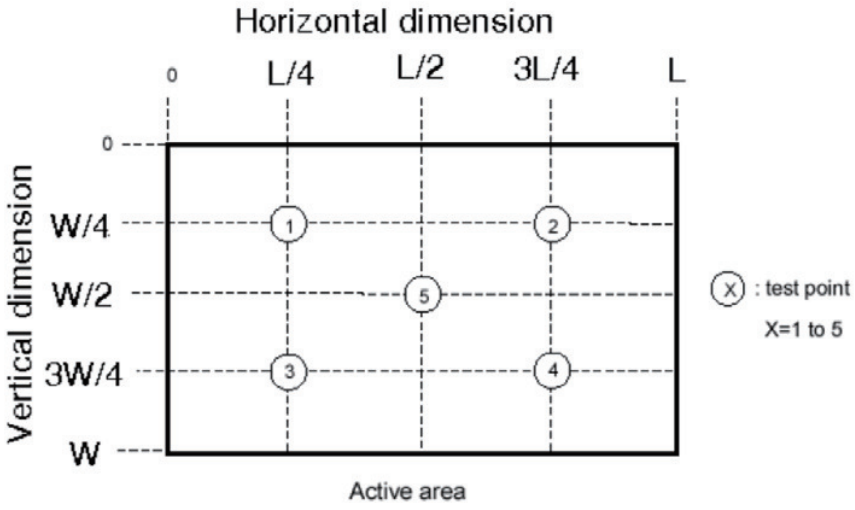
*** The above "Viewing Angle" is the measuring position with Largest Contrast Ratio; not for good image quality. View Direction for good image quality is 12 O'clock. Module maker can increase the "Viewing Angle" by applying Wide View Film.

*Note (4) Measurement Set-Up:

The LCD module should be stabilized at a given temperature for 20 minutes to avoid abrupt temperature change during measuring. In order to stabilize the luminance, the measurement should be executed after lighting Backlight for 20 minutes in a windless room.



*Note (5)


Horizontal dimension
0
L/4
L/2
3L/4
L
Vertical dimension
0
W/4
W/2
3W/4
W
1
2
5
3
4
X : test point
X=1 to 5
Active area

8. AC Characteristics

8.1 Input signal characteristics

Digital Serial RGB interface (960x240 resolution)

PARAMETER		Symbol	Min.	Typ.	Max.	Unit
CLK period		T_{OSC}	-	52	-	ns
Data setup time		T_{SU}	12	-	-	ns
Data hold time		T_{HD}	12	-	-	ns
IHS period		T_H	-	1224	-	T_{OSC}
IHS pulse width		T_{HS}	5	90	-	T_{OSC}
IHS setup time		T_{Cr}	12	-	-	ns
IHS hold time		T_{Cf}	12	-	-	ns
IVS pulse width		T_{VS}	1	3	5	T_H
IVS setup time		T_{Vr}	12	-	-	ns
IVS hold time		T_{Vf}	12	-	-	µs
IVS-DEN time	NTSC	T_{VSE}	-	18	-	T_H
	PAL	T_{VSE}	-	26	-	T_H
IHS-DEN time		T_{HE}	108	204	264	T_{OSC}
DEN pulse width		T_{EP}	-	960	-	T_{OSC}
DEN-STH time		T_{DES}	-	3	-	T_{OSC}
IVS period	NTSC	-	-	262.5	-	T_H
	PAL	-	-	312.5	-	T_H

Note: When SYNC mode is used, 1st data start from 204th CLK after IHS falling

Digital Parallel RGB interface (960x240 resolution)

PARAMETER		Symbol	Min.	Typ.	Max.	Unit
CLK period		T_{OSC}	-	156	-	ns
Data setup time		T_{SU}	12	-	-	ns
Data hold time		T_{HD}	12	-	-	ns
IHS period		T_H	-	408	-	T_{OSC}
IHS pulse width		T_{HS}	5	30	-	T_{OSC}
IHS setup time		T_{Cr}	12	-	-	ns
IHS hold time		T_{Cf}	12	-	-	ns
IVS pulse width		T_{VS}	1	3	5	T_H
IVS setup time		T_{Vr}	12	-	-	ns
IVS hold time		T_{Vf}	12	-	-	µs
IVS-DEN time	NTSC	T_{VSE}	-	18	-	T_H
	PAL	T_{VSE}	-	26	-	T_H
IHS-DEN time		T_{HE}	36	68	88	T_{OSC}
DEN pulse width		T_{EP}	-	320	-	T_{OSC}
DEN-STH time		T_{DES}	-	1	-	T_{OSC}
IVS period	NTSC	-	-	262.5	-	T_H
	PAL	-	-	312.5	-	T_H

Note: When SYNC mode is used, 1st data start from 68th CLK after IHS falling.

CCIR601/656 Interface

PARAMETER	Symbol	Min.	Typ.	Max.	Unit
CLK period	T_{OSC}	-	37	-	ns
Data setup time	T_{SU}	12	-	-	ns
Data hold time	T_{HD}	12	-	-	ns
IVS falling to IHS rising time for odd field	T_{HVO}	1	-	-	T_{OSC}
IVS falling to IHS falling time for even field	T_{HVE}	1	-	-	T_{OSC}

Hardware reset timing

PARAMETER	Symbol	Min.	Typ.	Max.	Unit
RESETB low pulse width	T_{RSB}	10	-	-	µs
STB to Vsync Setup Time	T_{STB}	20	-	-	ns

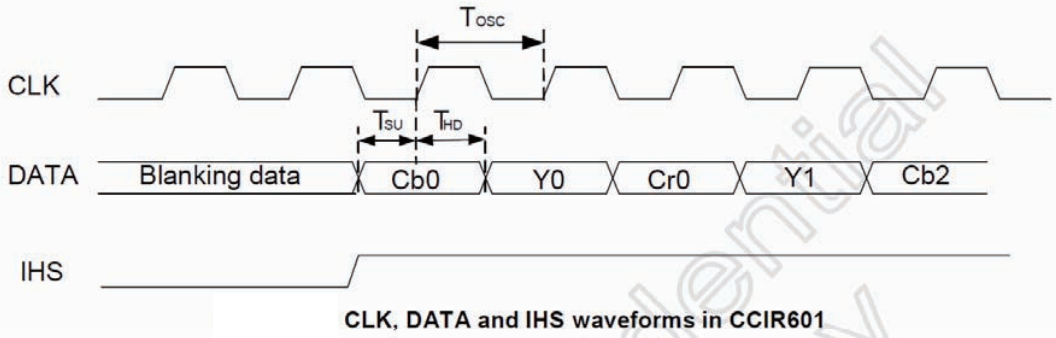
8.2 Output signal characteristics for digital input signal

PARAMETER		Symbol	Min.	Typ.	Max.	Unit
Rising time		T_r	-	-	10	ns
Falling time		T_f	-	-	10	ns
Internal STH setup time		T_{SUS}	12	-	-	ns
Internal STH hold time		T_{HDS}	12	-	-	ns
Internal data setup time		T_{SUD}	60	-	-	ns
Internal data hold time		T_{HDD}	40	-	-	ns
OEH pulse width		T_{OEH}	-	1248	-	ns
OEV pulse width		T_{OEV}	-	4992	-	ns
CKV pulse width		T_{CKV}	-	3744	-	ns
IHS-OEH time		T_1	-	4368	-	ns
IHS-CKV time		T_2	-	2496	-	ns
IHS-OEV time		T_3	-	624	-	ns
IHS-POL time		T_4	-	4368	-	ns
STV setup time		T_{SUV}	-	1872	-	ns
STV pulse width		T_{STV}	-	1	-	T_H
IVS-STV time	NTSC	T_{VS1}	-	19	-	T_H
	PAL	T_{VS1}	-	27	-	T_H
OEH-STV time		T_{OES}	-	2	-	T_H
Output settling time		T_{ST}	-	12	20	µs

8.3 Timing Controller Timing Chart

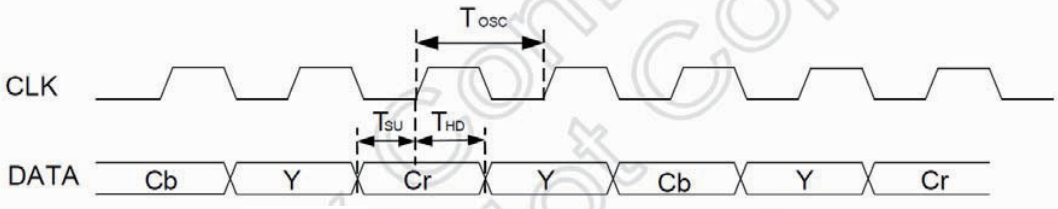
8.3.1 Clock and Data waveforms

- **CCIR601 (HS_POL=L in Register R2)**



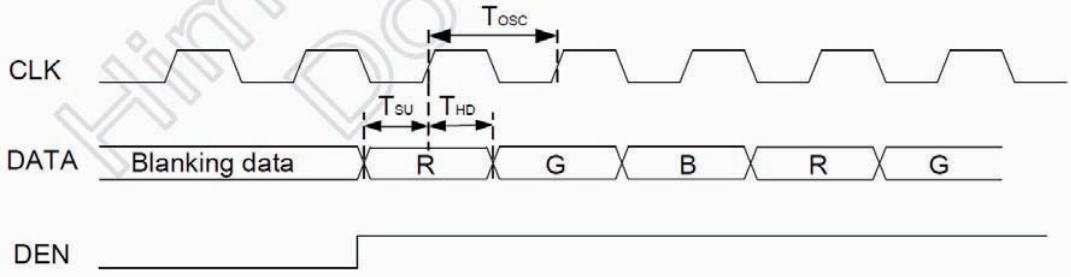
CLK, DATA and IHS waveforms in CCIR601

- **CCIR656**



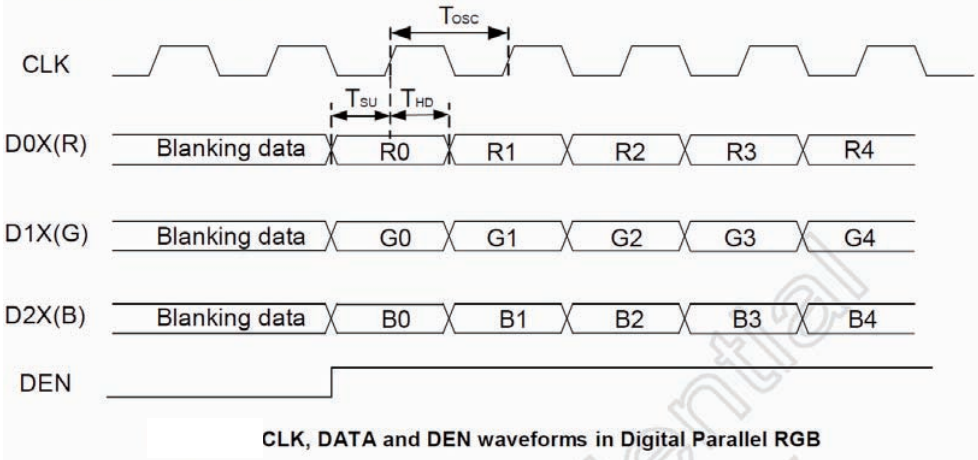
CLK and DATA waveforms in CCIR656

- **Digital Serial RGB**



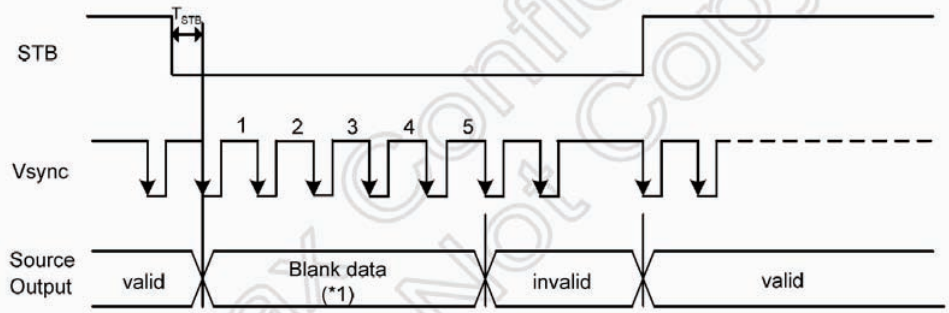
CLK, DATA and DEN waveforms in Digital Serial RGB

- **Digital Parallel RGB**



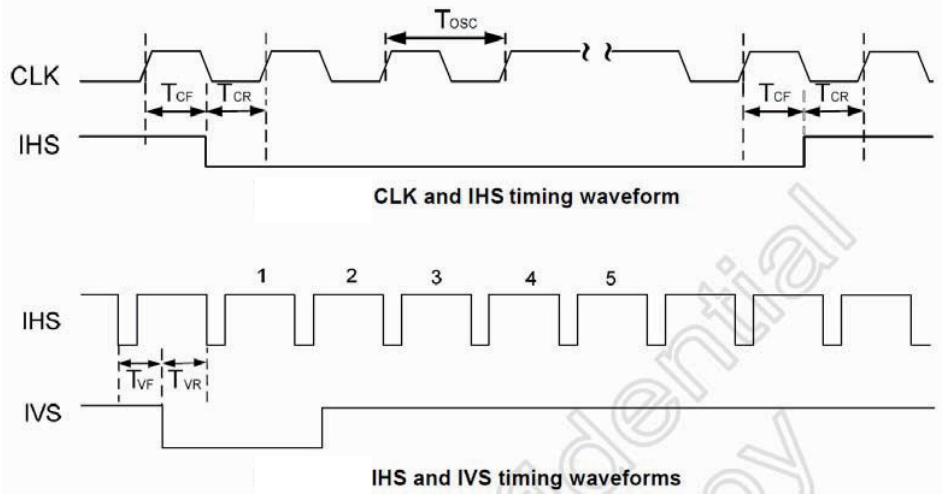
CLK, DATA and DEN waveforms in Digital Parallel RGB

- **Standby ON/OFF Control**



STB, VSYNC and Source Output waveforms in Standby ON/OFF Control

8.3.2 Clock and Sync waveforms

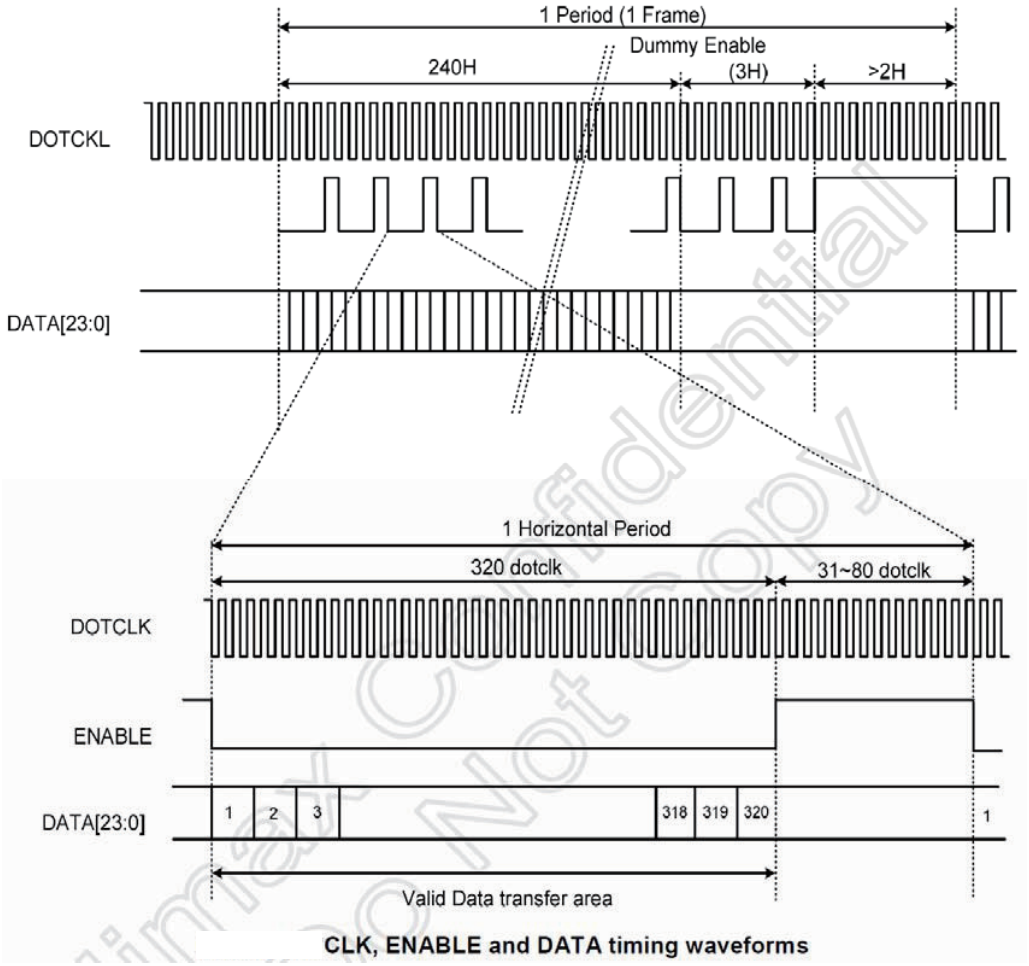


CLK and IHS timing waveform

IHS and IVS timing waveforms

8.3.3 Digital RGB timing waveform

- **DE Only Mode**

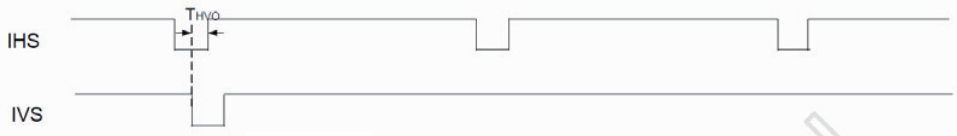


CLK, ENABLE and DATA timing waveforms

8.3.4 CCIR601 timing waveform VS_POL=H, HS_POL=L in Register R2)

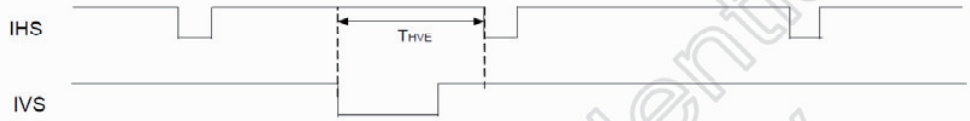
IHS and IVS timing

- Odd field



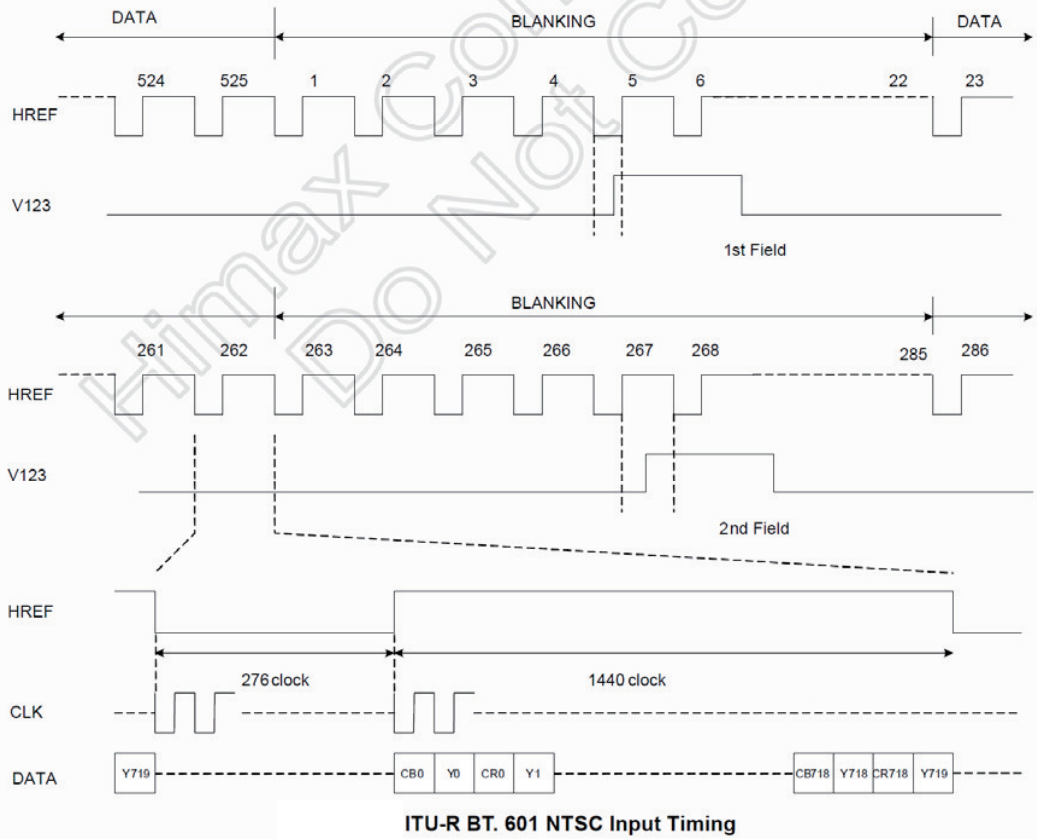
IHS and IVS waveforms in odd field

- Even field

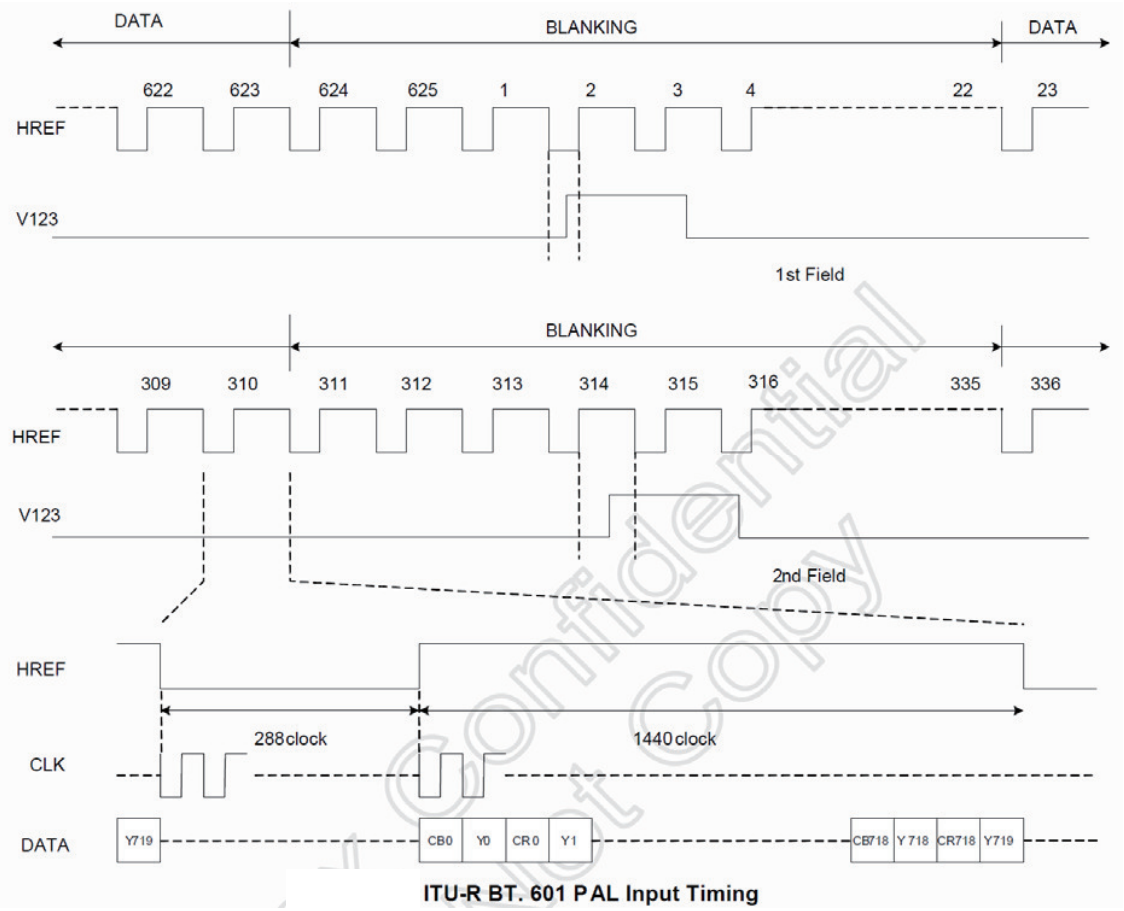


IHS and IVS waveforms in even field

IHS and IVS timing



ITU-R BT. 601 NTSC Input Timing

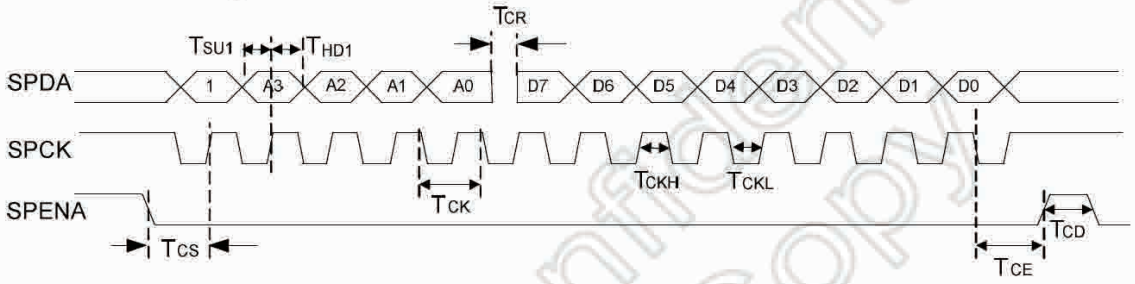


ITU-R BT. 601 PAL Input Timing

8.3.5 SPI timing characteristics

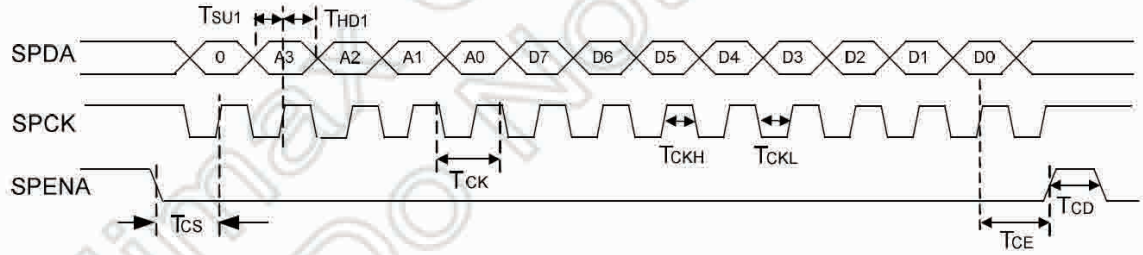
PARAMETER	Symbol	Min.	Typ.	Max.	Unit
SPCK period	T_{CK}	60	-	-	ns
SPCK high width	T_{CKH}	30	-	-	ns
SPCK low width	T_{CKL}	30	-	-	ns
Data setup time	T_{SU1}	12	-	-	ns
Data hold time	T_{HD1}	12	-	-	ns
SPENA to SPCK setup time	T_{CS}	20	-	-	ns
SPENA to SPDA hold time	T_{CE}	20	-	-	ns
SPENA high pulse width	T_{CD}	50	-	-	ns
SPDA output latency	T_{CR}	-	1/2	-	T_{CK}

- **SPI read timing**



SPI read timing

- **SPI write timing**



SPI write timing

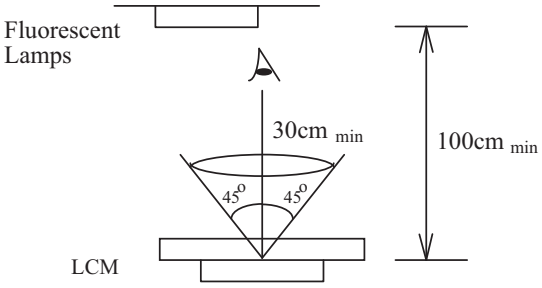
9.Quality Specifications

All The raw material are Rohs complicant.

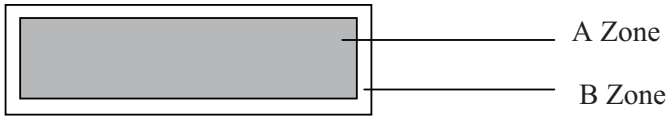
9.1 Standard of the product appearance test

Manner of appearance test: The inspection should be performed in using 20W x 2 fluorescent lamps. Distance between LCM and fluorescent lamps should be 100 cm or more. Distance between LCM and inspector eyes should be 30 cm or more.

Viewing direction for inspection is 45° from vertical against LCM.



Definition of zone:



A Zone: viewing area
B Zone: outside viewing area

9.2 Specification of quality assurance

AQL inspection standard

Sampling method: MIL-STD-105E, Level II, single sampling

Defect classification (Note: * is not including)

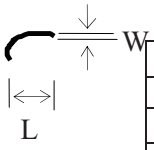
Classify	Item		Note	AQL
Major	Display state	Short or open circuit	1	0.65
		LC leakage		
		Flickering		
		No display		
		Wrong viewing direction		
		Contrast defect (dim, ghost)	2	
		Back-light	1,8	
	Non-display	Flat cable or pin reverse	10	
		Wrong or missing component	11	
Minor	Display state	Background color deviation	2	1.0
		Black spot and dust	3	
		Line defect, Scratch	4	
		Rainbow	5	
		Chip	6	
		Pin hole	7	
	Polarizer	Protruded	12	
		Bubble and foreign material	3	
	Soldering	Poor connection	9	
	Wire	Poor connection	10	
	TAB	Position, Bonding strength	13	

Note on defect classification

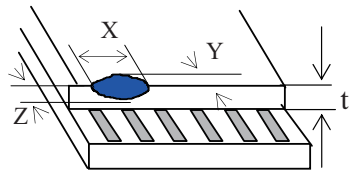
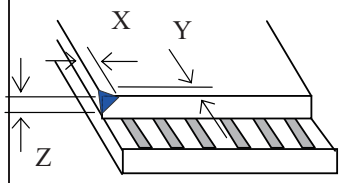
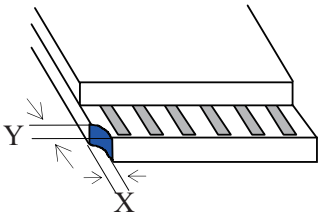
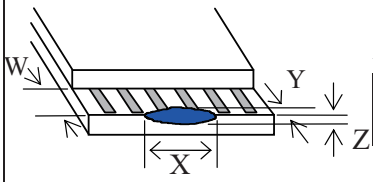
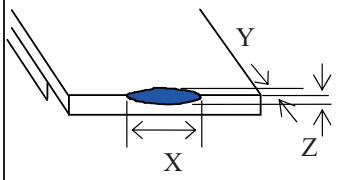
<table>
<tr><th>No.</th><th>Item</th><th>Criterion</th></tr>
<tr><td rowspan="6">1</td><td>Short or open circuit</td><td rowspan="6">Not allow</td></tr>
<tr><td>LC leakage</td></tr>
<tr><td>Flickering</td></tr>
<tr><td>No display</td></tr>
<tr><td>Wrong viewing direction</td></tr>
<tr><td>Wrong Back-light</td></tr>
<tr><td rowspan="2">2</td><td>Contrast defect</td><td rowspan="2">Refer to approval sample</td></tr>
<tr><td>Background color deviation</td></tr>
<tr><td>3</td><td>Point defect,
Black spot, dust
(including Polarizer)

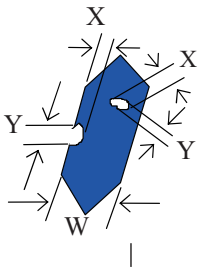
Φ= (X+Y)/2</td><td> 

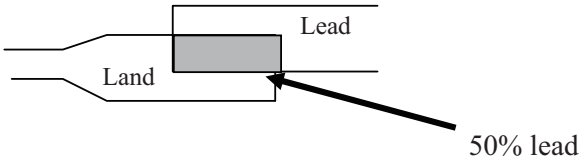
<table>
<tr><th>Point
Size</th><th>Acceptable Qty.</th></tr>
<tr><td>Φ≤0.10</td><td>Disregard</td></tr>
<tr><td>0.10 <Φ≤ 0.20</td><td>3</td></tr>
<tr><td>0.20 <Φ≤ 0.25</td><td>2</td></tr>
<tr><td>0.25 <Φ≤ 0.30</td><td>1</td></tr>
<tr><td>Φ >0.30</td><td>0</td></tr>
</table>
Unit：mm</td></tr>
<tr><td>4</td><td>Line defect,

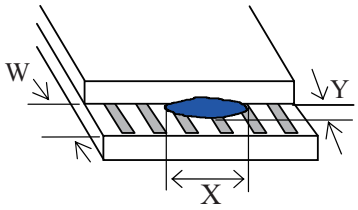
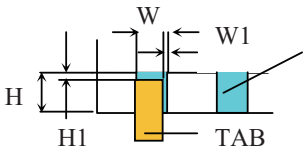
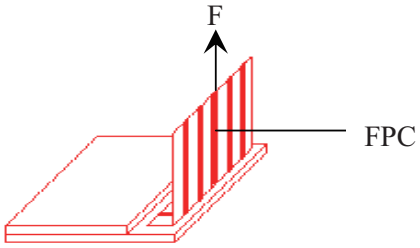
Scratch</td><td> 

<table>
<tr><th colspan="2">Line</th><th>Acceptable Qty.</th></tr>
<tr><td>L</td><td>W</td><td></td></tr>
<tr><td>---</td><td>0.02≥W</td><td>Disregard</td></tr>
<tr><td>4.0≥L</td><td>0.03≥W>0.02</td><td rowspan="2">2</td></tr>
<tr><td>2.0≥L</td><td>0.05≥W>0.03</td></tr>
<tr><td>1.0≥L</td><td>0.1＞W>0.05</td><td>1</td></tr>
<tr><td>---</td><td>0.1< W</td><td>Applied as point defect</td></tr>
</table>
Unit: mm</td></tr>
<tr><td>5</td><td>Rainbow</td><td>Not more than two color changes across the viewing area.</td></tr>
</table>

No	Item	Criterion
6	Chip Remark: X: Length direction Y: Short direction Z: Thickness direction t: Glass thickness W: Terminal Width	 Acceptable criterion X: ⩽2; Y: 0.5mm; Z: ⩽t/2  Acceptable criterion X: ⩽2; Y: 0.5mm; Z: ⩽t  Acceptable criterion X: ⩽3; Y: ⩽2; Z: ⩽t shall not reach to ITO  Acceptable criterion X: Disregard; Y: ⩽0.2; Z: ⩽t  Acceptable criterion X: ⩽5; Y: ⩽2; Z: ⩽t/3

<table>
<tr><th>No.</th><th>Item</th><th>Criterion</th></tr>
<tr><td>7</td><td>Segment
pattern
W = Segment width
φ = (X+Y)/2</td><td>(1) Pin hole
□ < 0.10mm is acceptable.
 

<table>
<tr><th>Point Size</th><th>Acceptable Qty</th></tr>
<tr><td>φ≤1/4W</td><td>Disregard</td></tr>
<tr><td>1/4W<φ≤1/2W</td><td>1</td></tr>
<tr><td>φ>1/2W</td><td>0</td></tr>
</table>
Unit: mm</td></tr>
<tr><td>8</td><td>Back-light</td><td>(1) The color of backlight should correspond its specification.
(2) Not allow flickering</td></tr>
<tr><td>9</td><td>Soldering</td><td>(1) Not allow heavy dirty and solder ball on PCB.
(The size of dirty refer to point and dust defect)
(2) Over 50% of lead should be soldered on Land.
 
</td></tr>
<tr><td>10</td><td>Wire</td><td>(1) Copper wire should not be rusted
(2) Not allow crack on copper wire connection.
(3) Not allow reversing the position of the flat cable.
(4) Not allow exposed copper wire inside the flat cable.</td></tr>
<tr><td>11*</td><td>PCB</td><td>(1) Not allow screw rust or damage.
(2) Not allow missing or wrong putting of component.</td></tr>
</table>

No	Item	Criterion
12	Protruded W: Terminal Width	 Acceptable criteria: Y ≤0.4
13	TAB	1. Position  W1≤1/3W H1≤1/3H 2 FPC bonding strength test  P (=F/FPC bonding width) ≥650gf/cm ,(speed rate: 1mm/min) 5pcs per SOA (shipment)
14	Total no. of acceptable Defect	A. Zone Maximum 2 minor non-conformities per one unit. Defect distance: each point to be separated over 10mm B. Zone It is acceptable when it is no trouble for quality and assembly in customer's end product.

9.3 Reliability of LCM

Reliability test condition:

Item	Condition	Time (hrs)	Assessment
High temp. Storage	60°C	48	No abnormalities in functions and appearance
High temp. Operating	50°C	48	
Low temp. Storage	-10°C	48	
Low temp. Operating	0°C	48	
Humidity	40°C/ 90%RH	48	
Temp. Cycle	-10°C ← 25°C → 60°C (60 min ← 5 min → 60min)	10cycles	

Recovery time should be 24 hours minimum. Moreover, functions, performance and appearance shall be free from remarkable deterioration within 50,000 hours under ordinary operating and storage conditions room temperature (20±8°C), normal humidity (below 65% RH), and in the area not exposed to direct sun light.

9.4 Precaution for using LCD/LCM

LCD/LCM is assembled and adjusted with a high degree of precision. Do not attempt to make any alteration or modification. The followings should be noted.

General Precautions:

1. LCD panel is made of glass. Avoid excessive mechanical shock or applying strong pressure onto the surface of display area.
2. The polarizer used on the display surface is easily scratched and damaged. Extreme care should be taken when handling. To clean dust or dirt off the display surface, wipe gently with cotton, or other soft material soaked with isoproply alcohol, ethyl alcohol or trichlorotriflorothane, do not use water, ketone or aromatics and never scrub hard.
3. Do not tamper in any way with the tabs on the metal frame.
4. Do not made any modification on the PCB without consulting Orient Display.
5. When mounting a LCM, make sure that the PCB is not under any stress such as bending or twisting. Elastomer contacts are very delicate and missing pixels could result from slight dislocation of any of the elements.
6. Avoid pressing on the metal bezel, otherwise the elastomer connector could be deformed and lose contact, resulting in missing pixels and also cause rainbow on the display.
7. Be careful not to touch or swallow liquid crystal that might leak from a damaged cell. Any liquid crystal adheres to skin or clothes, wash it off immediately with soap and water.

Static Electricity Precautions:

1. CMOS-LSI is used for the module circuit; therefore operators should be grounded whenever he/she comes into contact with the module.
2. Do not touch any of the conductive parts such as the LSI pads; the copper leads on the PCB and the interface terminals with any parts of the human body.
3. Do not touch the connection terminals of the display with bare hand; it will cause disconnection or defective insulation of terminals.
4. The modules should be kept in anti-static bags or other containers resistant to static for storage.
5. Only properly grounded soldering irons should be used.
6. If an electric screwdriver is used, it should be grounded and shielded to prevent sparks.
7. The normal static prevention measures should be observed for work clothes and working benches.
8. Since dry air is inductive to static, a relative humidity of 50-60% is recommended.

Soldering Precautions:

1. Soldering should be performed only on the I/O terminals.
2. Use soldering irons with proper grounding and no leakage.
3. Soldering temperature: 280°C±10°C
4. Soldering time: 3 to 4 second.
5. Use eutectic solder with resin flux filling.
6. If flux is used, the LCD surface should be protected to avoid spattering flux.
7. Flux residue should be removed.

Operation Precautions:

1. The viewing angle can be adjusted by varying the LCD driving voltage Vo.
2. Since applied DC voltage causes electro-chemical reactions, which deteriorate the display, the applied pulse waveform should be a symmetric waveform such that no DC component remains. Be sure to use the specified operating voltage.
3. Driving voltage should be kept within specified range; excess voltage will shorten display life.
4. Response time increases with decrease in temperature.
5. Display color may be affected at temperatures above its operational range.
6. Keep the temperature within the specified range usage and storage. Excessive temperature and humidity could cause polarization degradation, polarizer peel-off or generate bubbles.
7. For long-term storage over 40°C is required, the relative humidity should be kept below 60%, and avoid direct sunlight.

Limited Warranty

Orient Display LCDs and modules are not consumer products, but may be incorporated by Orient Display customers into consumer products or components thereof, Orient Display does not warrant that its LCDs and components are fit for any such particular purpose.

1. The liability of Orient Display is limited to repair or replacement on the terms set forth below. Orient Display will not be responsible for any subsequent or consequential events or injury or damage to any personnel or user including third party personnel and/or user. Unless otherwise agreed in writing between Orient Display and the customer, Orient Display will only replace or repair any of its LCD which is found defective electrically or visually when inspected in accordance with Orient Display general LCD inspection standard. (Copies available on request)
2. No warranty can be granted if any of the precautions state in handling liquid crystal display above has been disregarded. Broken glass, scratches on polarizer mechanical damages as well as defects that are caused accelerated environment tests are excluded from warranty.
3. In returning the LCD/LCM, they must be properly packaged; there should be detailed description of the failures or defect.