TFT Module Specification

ITEM NO.: FG030510ANCWA-01

Table of Contents

R&D Dept.	Q.C. Dept.	Eng. Dept.	Prod. Dept.
Version:	Issued Date:	Sheet Code:	Total Pages:
	2002/8/9		28

2. RECORD OF REVISION

Rev	Date	Item	Page	Comment

3. Application

This technical specification applies to 3.5” color TFT-LCD panel. The 3.5” color TFT-LCD
panel is designed for camcorder, digital camera application and other electronic products which
require high quality flat panel displays.

4. Features

. Compatible with NTSC and PAL system

. High Resolution :112,320 Dots (480 x 234)

. Image Reversion: Up/Down and Left/Right

5. GENERAL Specifications

Parameter		Specifications	Unit
Screen Size		3.5 (diagonal)	inch
Display Format		480 x 234	dot
Active Area		71.6 (H) x 52.65 (V)	mm
Dot Pitch		0.149 (H) x 0.225 (V)	mm
Surface Treatment		Anti-Glare	
Pixel Configuration		Delta	
Outline Dimension		83.7 (W) x 68.6 (H) x 6.6 (T)	mm
Weight		TBD	g
View Angle direction		6 o’clock	
Temperature Range	Operation	0~60	°C
	Storage	-20~70	°C

6. Absolute Maximum Ratings:

GND = 0 V, Ta = 25 °C

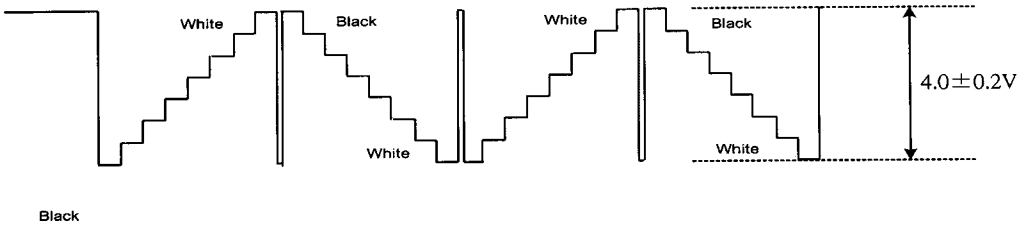
Parameter		Symbol	MIN.	MAX.	Unit	Remark
Supply Voltage for Source Driver	Analog	AV_{DD}	-0.3	7.0	V	
	Digital	V_{DD}	-0.3	7.0		
Supply Voltage for Gate Driver	Positive	V_{GH}	-0.3	45.0	V	
	Negative	V_{GL}	-23	0.3	V	
		V_{GH}-V_{GL}	15	40	V	
Analog input voltage (V_R,V_G,V_B)		V_{video}	-0.3	7.3	V	

7. Electrical Characteristics

7.1 Operating Conditions:

Parameter		Symbol	MIN.	TYP	MAX.	Unit	Remark
Power Supply		V_{CC}	4.5	5.0	5.5	V	
		V_{DD}	3.5	3.3	3.6	V	
		AV_{DD}	4.5	5.0	5.5	V	
		V_{GH}	14.5	15	15.5	V	
		V_{EE}	-15.5	-15	-14.5	V	
		$V_{GL\ AC}$	--	6.0	--	V_{P-P}	AC component of V_{GL}
		$V_{GL\ DC}$	-12.5	-11.0	-9.5	V	DC component of V_{GL}
Video Signal (V_R,V_G,V_B)		$V_{i\ AC}$	--	4.0	4.2	V_{P-P}	AC component Note7-1
		$V_{i\ DC}$	--	2.5	--	V	DC component
V_{COM}		$V_{COM\ AC}$	--	6.0	--	V	AC component of V_{COM}
		$V_{COM\ DC}$	0.9	1.0	1.1	V	DC component of V_{COM}
	H Level	V_{IH}	+0.7 V_{DD}	--	--	V	
	L level	V_{IL}	--	--	+0.3 V_{DD}	V	Note 7-1

Note 7-1: Both NTSC and PAL system Video Signal input waveform is based on 8 steps gray scale.



Note 7-2: STH1,STH2,CPH1,CPH2,CPH3,Q2H,INH,CPV,XOE,DIO1,DIO2

7-2 Current Consumption

Ta= 25 °C

Parameter	Symbol	Conditions	Min	TYP.	Max.	Unit	Remark
Current for Driver	I_{GH}	V_{GH} = +15V	--	0.026	0.03	mA	
	I_{GL}	V_{GL} = -12V	--	0.35	0.4	mA	V_{GL} center voltage
	I_{CC}	V_{CC} = +5V	--	0.1	0.15	mA	
	AI_{DD}	AV_{DD} = +5V	--	1.73	1.83	mA	
	I_{DD}	V_{DD} = +5V	--	0.66	0.7	mA	
	I_{EE}	V_{EE} = -15V	--	0.1	0.15	mA	

7-3 Backlight Driving for Power Consumption

Pin No	Symbol	Description	Remark
1	VL1	Input terminal (Hi voltage side)	
3	VL2	Input terminal(Low voltage side)	Note7-3

Note7-3 : Low voltage side of backlight inverter connects with ground of inverter circuits.

Ta= 25 °C

Parameter	Symbol	Min.	Typ.	Max.	Unit	Remark
Lamp voltage	V_L	--	TBD	--	Vrms	I_L=3mA
Lamp current	I_L	--	3	--	mA	
Lamp frequency	P_L	25	35	45	KHz	Note7-4
Kick –off voltage(25 °C)	V_S	--	--	400	Vrms	
Kick –off voltage(0 °C)	V_S	--	--	520	Vrms	
Lamp Life Time		10,000	20,000	--	hr	

Note7-4 :The waveform of lamp driving voltage should be as closed to a perfect SIN wave as possible.

7-4. Power Consumption

Parameter	Symbol	Conditions	TYP.	Unit	Remark
LCD Panel Power Consumption			18.5	mW	Note7-5
Backlight Lamp Power Consumption			0.71	W	Note7-6
Total Power Consumption			0.73	W	

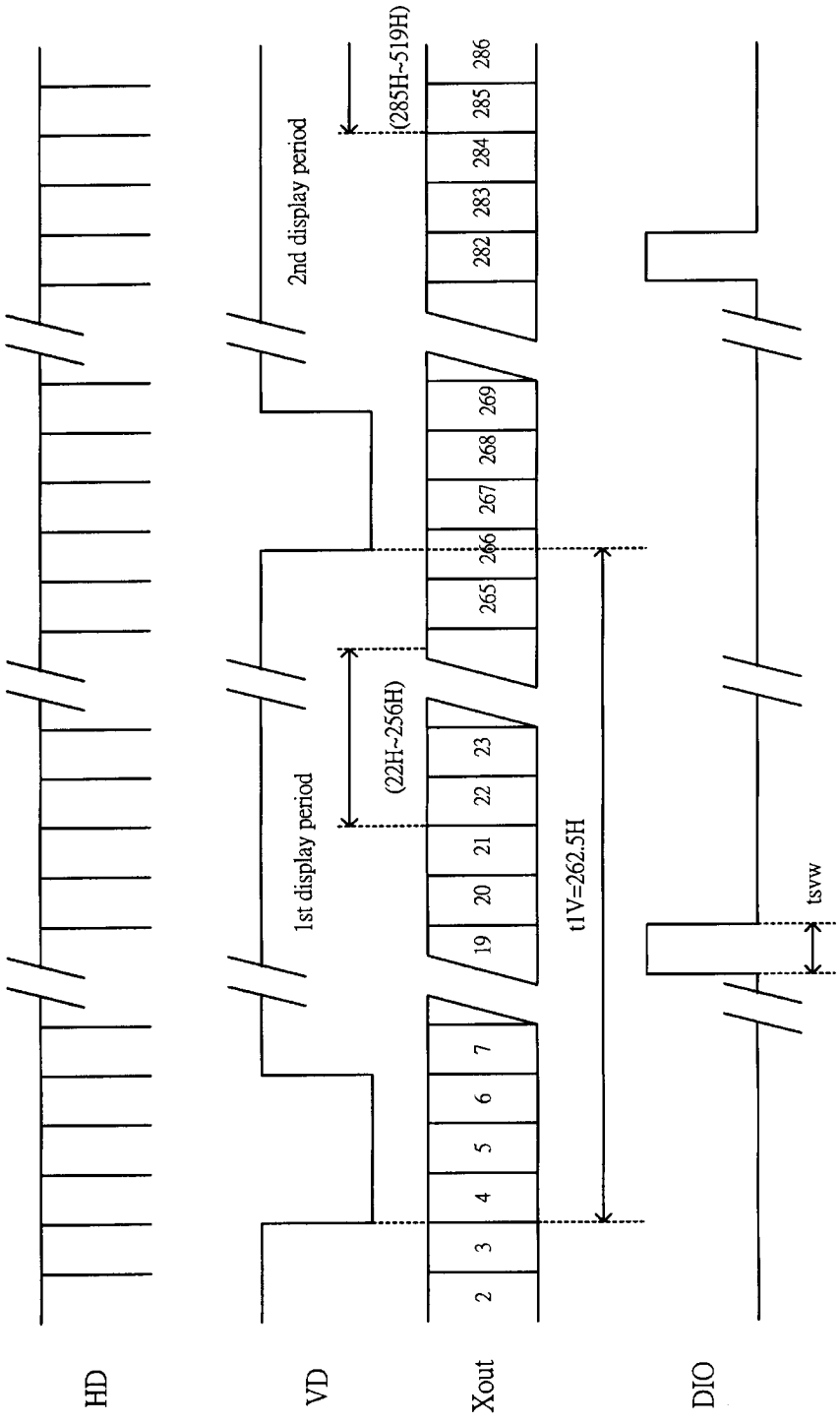
Note7-5: The power consumption for backlight is not included.
Note7-6: Backlight lamp power consumption is calculated by I_L X V_L.

7-3. Timing Characteristics of Input Signals

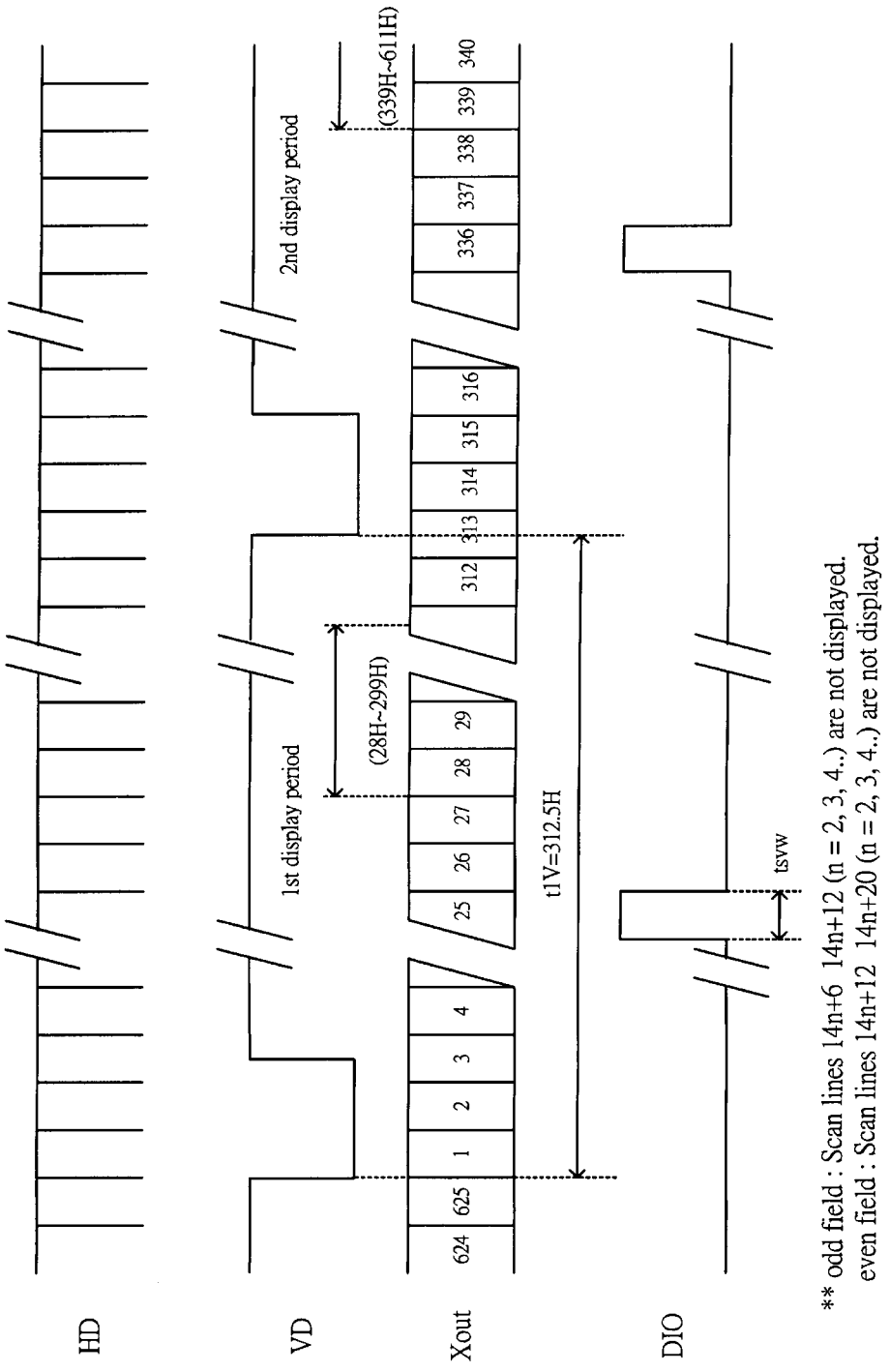
Characteristics	Symbol	Min.	TYP.	Max.	Unit	Remark
1 Field Scanning Period	t1V		262.5		H	
1Line Scanning Period	t1H		63.5		μs	
Source Driver Operating Frequency	fhc	1.0	3.14	5.0	MHZ	
Signal Sampling Pulse width	tchw	200	317.7	1000	ns	
Signal Sampling Pulse Delay	tchd	95.3	105.9	116.5	ns	tchd 12,23
Signal Sampling Pulse width(H)	tchwh	142.9	158.8	174.7	ns	
Signal Sampling Pulse Delay(L)	tchwl	142.9	158.8	174.7	ns	
Source Start Signal Pulse Width	tshw	90	317.7	630*	ns	*tshset=tshhld
Source Start Signal Setup Time	tshset	20	158.8	-	ns	
Source Start Signal Hold Time	tshhld	20	158.8	-	ns	
Source Output Enable Pulse Width	tohw	1.0	2.0	-	μs	
Source Start Signal Rising Time	tss	-	9.8	-	μs	
Video Input Signal Start Point	tvs	-	10.0	-	μs	
Phase Difference Between OEH & CPV	toc	1.5	2.3	-	μs	
Gate Clock Period	tcvw	10	63.5	-	μs	
Gate Clock Pulse Width(H)	tcvwh	10	31.7	48	μs	
Gate Clock Pulse Width(L)	tcvwl	10	31.7	48	μs	
Gate Start Signal Pulse Width	tsvw	5	63.5	126**	μs	**tsvset=tsvhld
Gate Start Signal Setup Time	tsvset	5	53.2	-	μs	
Gate Start Signal Hold Time	tsvhld	5	10.3	-	μs	
Phase Difference Between OEH & STH	tosp	-	4	-	μs	
Phase Difference Between SYNC & OEH	tohs	-	1.4	-	μs	
Gate Output Enable Pulse Width	toev	-	2.5	-	μs	
V_{COM} Delay Time	t_{DCOM}	-	-	3	μs	
RGB Delay Start	t_{DRGB}	-	-	2	μs	
Vertical Display Start	tsv	-	3	-	tH	

(1) Signal Timing Waveforms

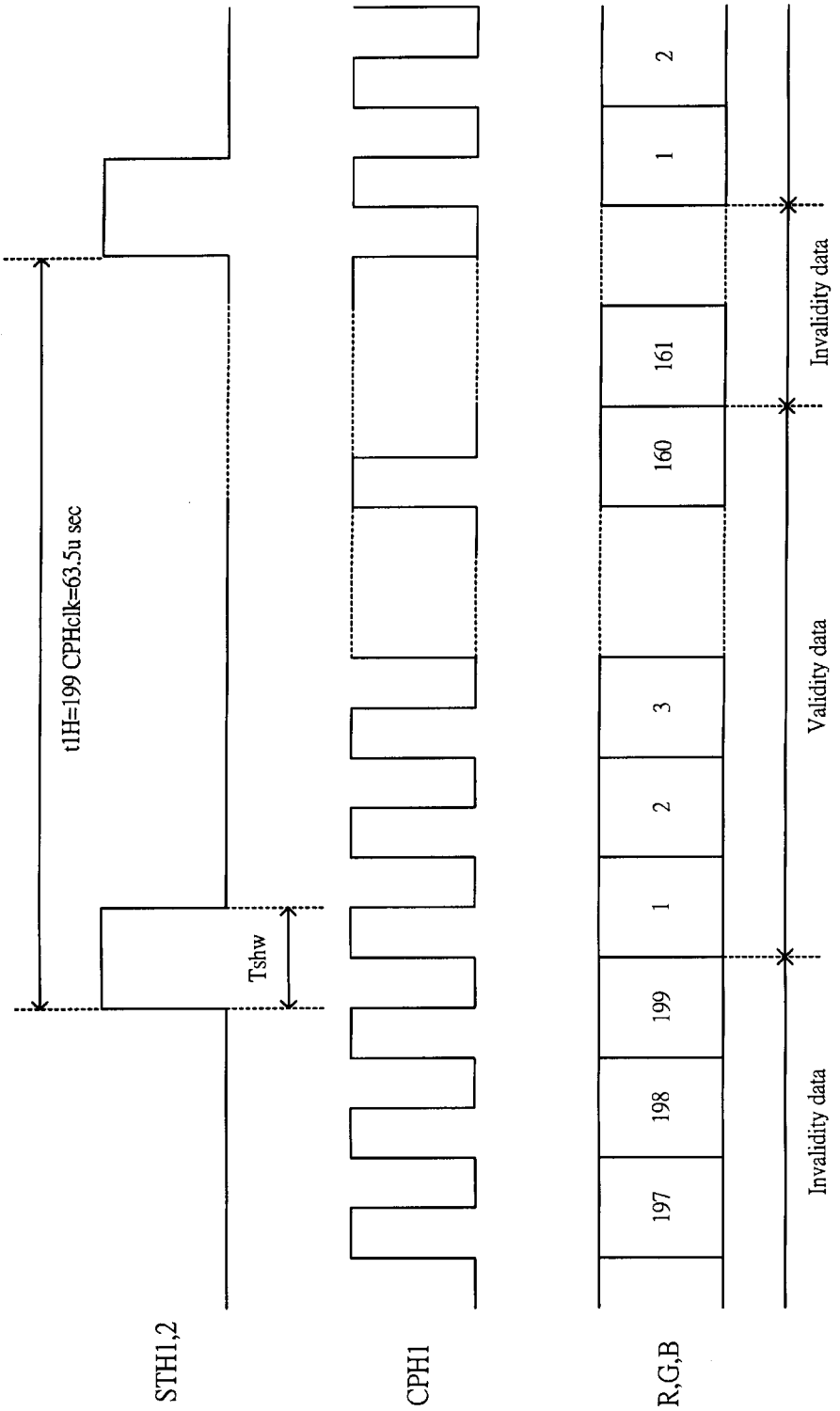
Vertical Start Line for NTSC



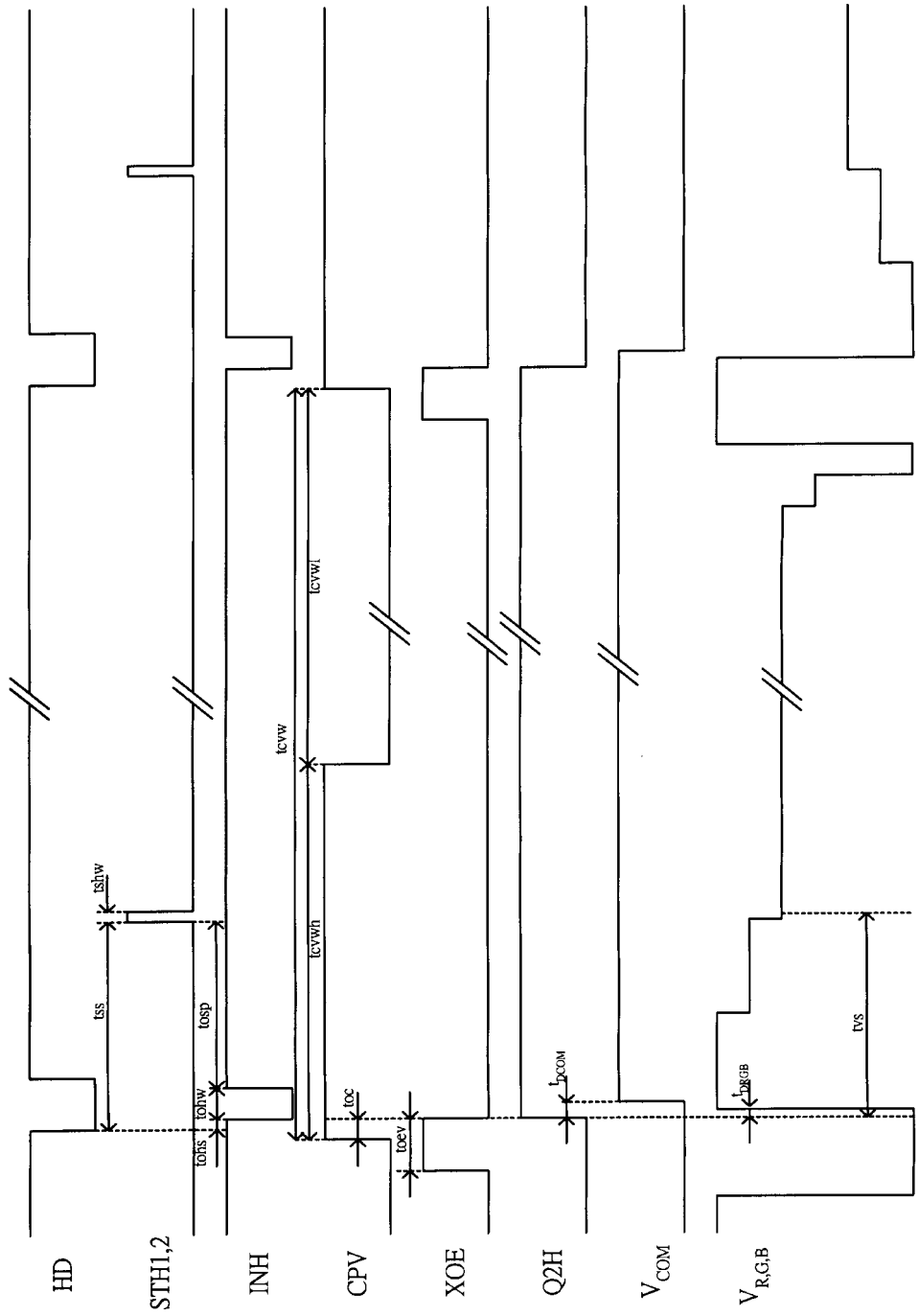
(2) Vertical Start Line for PAL



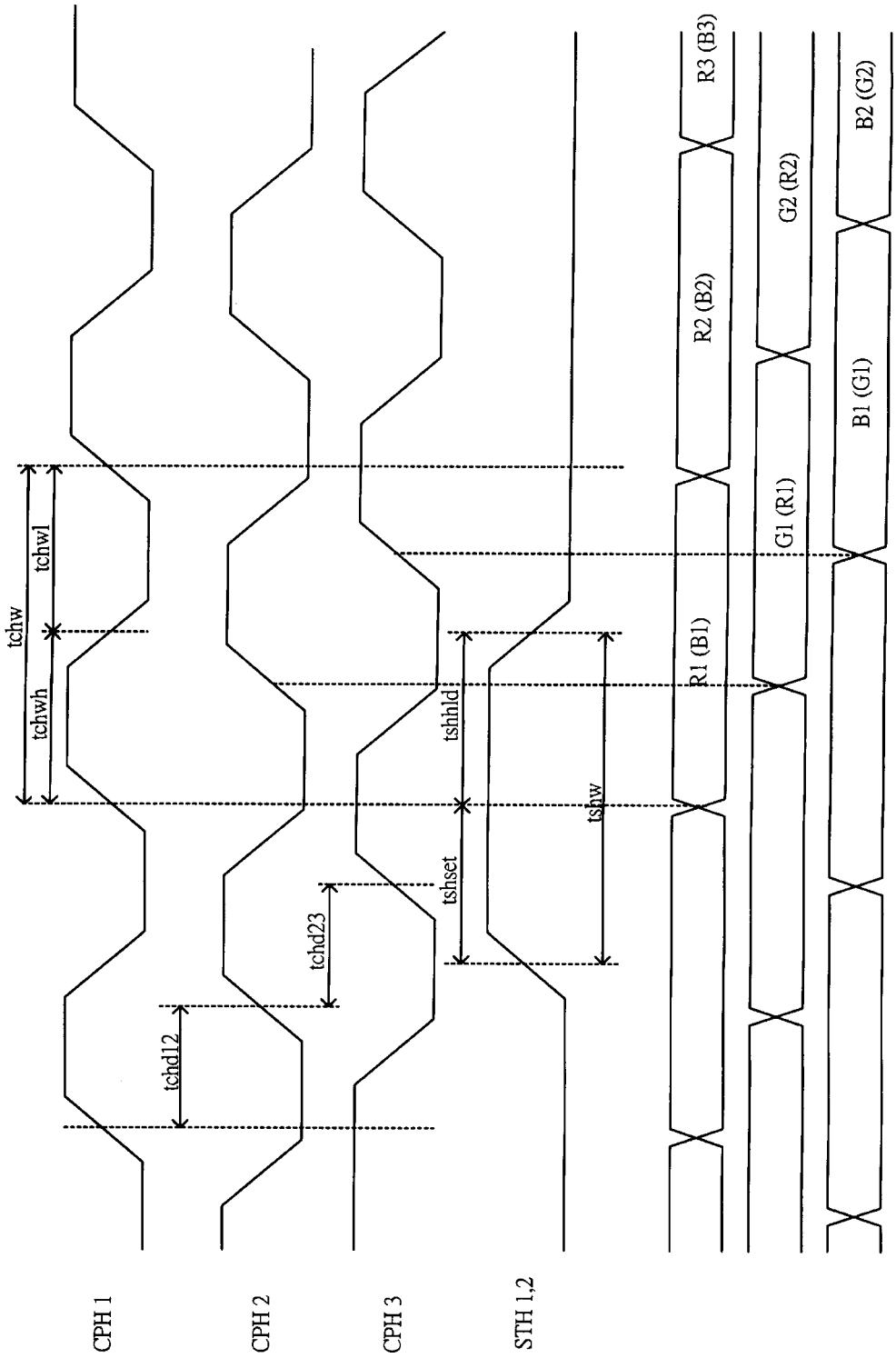
(3) Horizontal Start Pixel



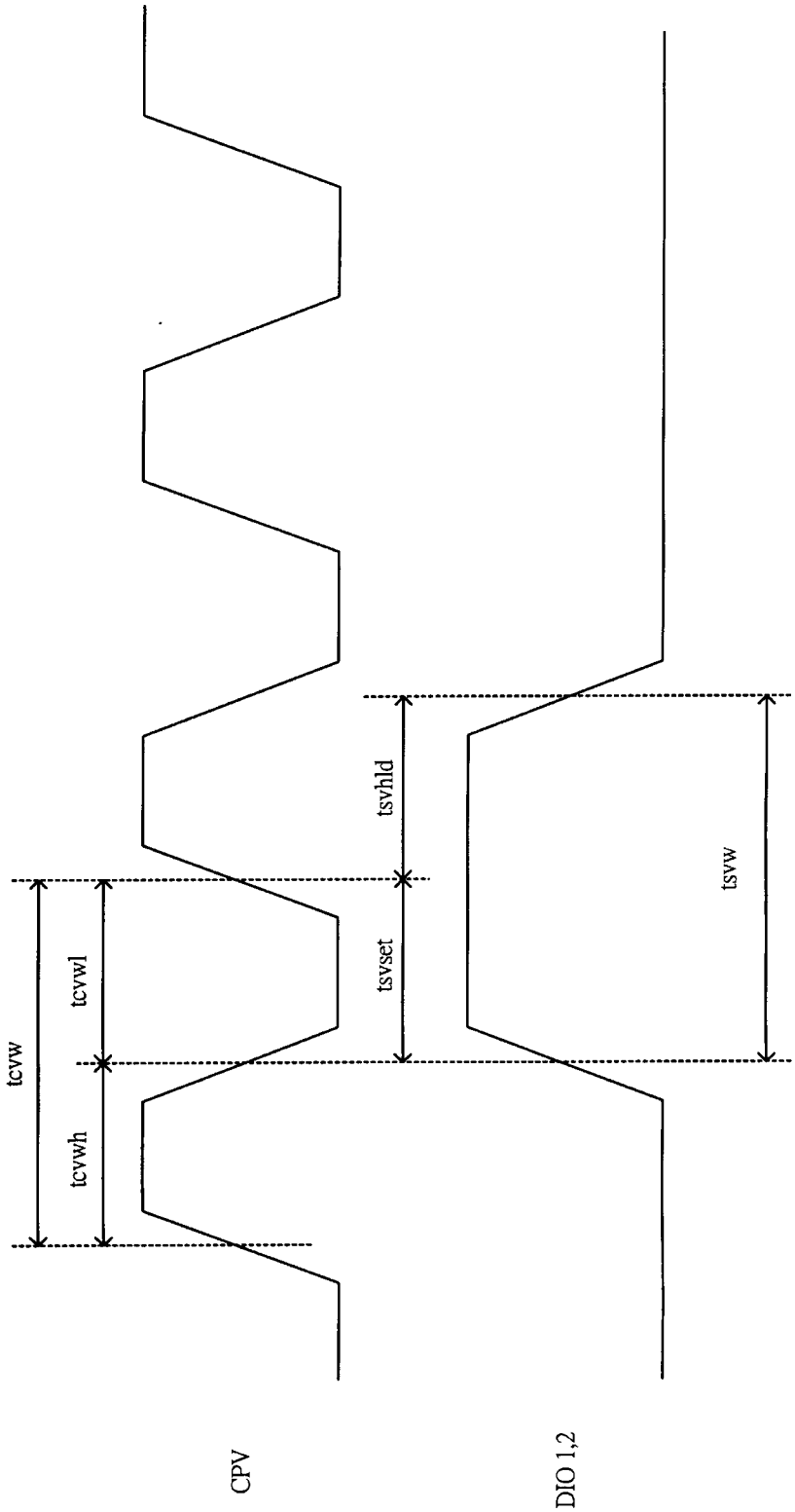
(4) Detail Horizontal Timing



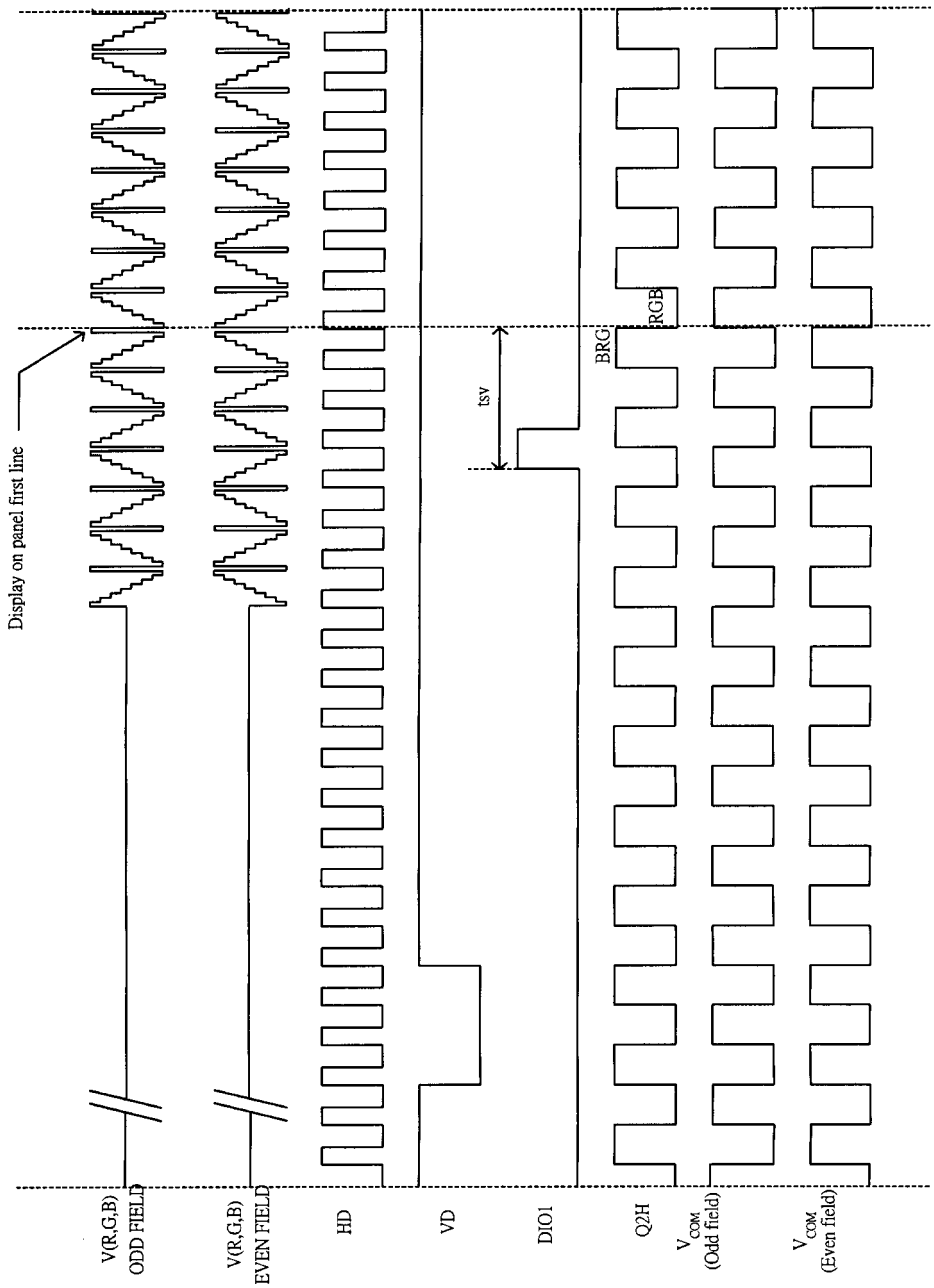
(5) Sampling Clock Timing



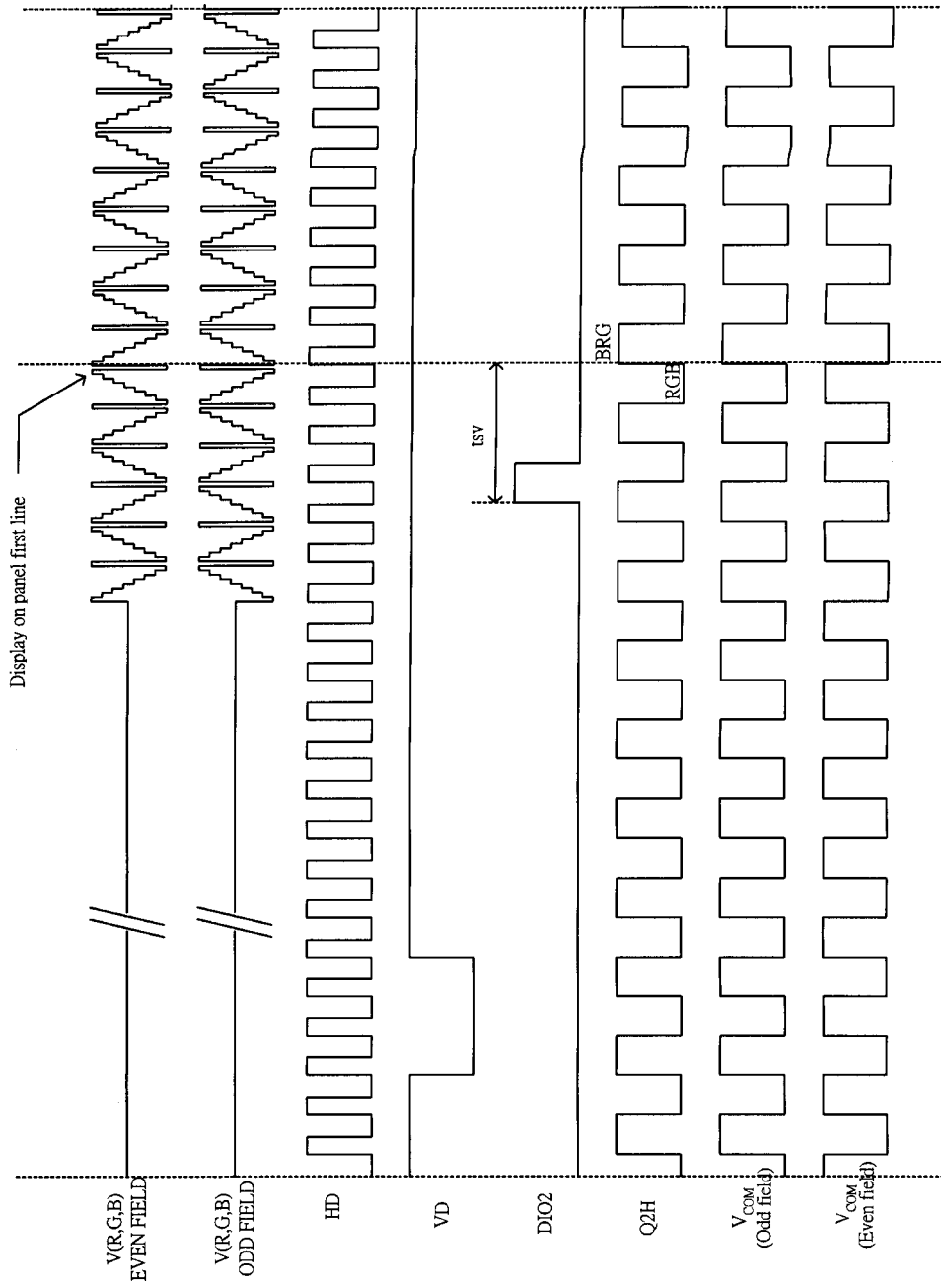
(6) Vertical Shift Clock Timing



(7) Vertical Timing (from Up to Down)

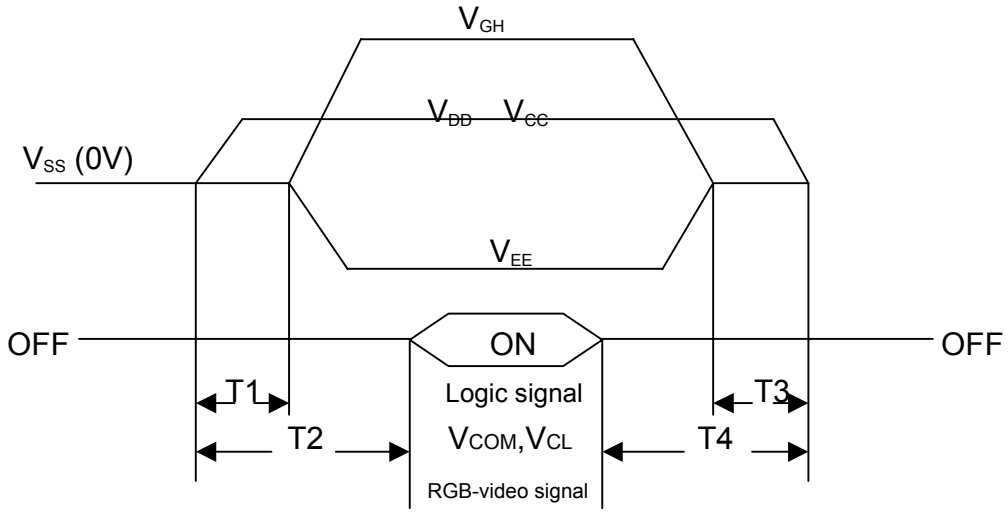


(7-1) Vertical Timing (from Down to Up)



7-4 Power on Sequence (Voltage source)

The Power on Sequence only effect by V_{CC} ,V_{SS} ,V_{EE} ,V_{DD} and V_{GH} the others do not care.



1.10ms≤T1<T2

2. 0ms<T3≤T4≤10ms

8. Optical Characteristics

8-1. Specification:

Ta = 25℃

Parameter		Symbol	Condition	MIN.	TYP.	MAX.	Unit	Remarks
Viewing Angle	Horizontal	θ	CR≥10	±45	±50		deg	Note 8-2
	Vertical	θ (to 12 o'clock)		10	15		deg	
		θ (to 6 o'clock)		30	35		deg	
Contrast Ratio		CR		110	150			Note 8-1
Response time	Rise	Tr	θ=0° φ=0°		15	30	ms	Note 8-4
	Fall	Tf			25	50	ms	
Transmission	Ratio	T		7.5	8.0	8.5	%	
Uniformity		U		65	70			
Brightness				200	250		cd/m^2	Note 8-2
Chromaticity	White	x	θ=0°	0.250	0.300	0.350		Note 8-2
		y		0.280	0.330	0.380		
		Tc		6650	6850	7050		

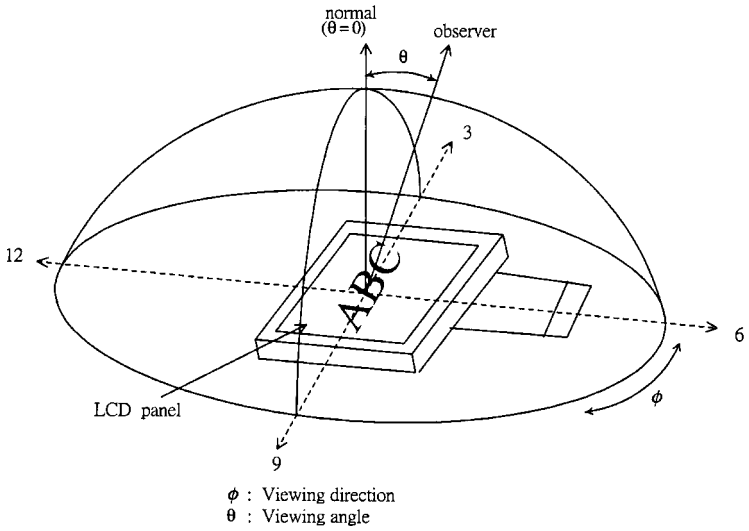
Note 8-1：CR ＝ $\frac{\text{Luminance when LCD is White}}{\text{Luminance when LCD is Black}}$

Contrast Ratio is measured in optimum common electrode voltage.

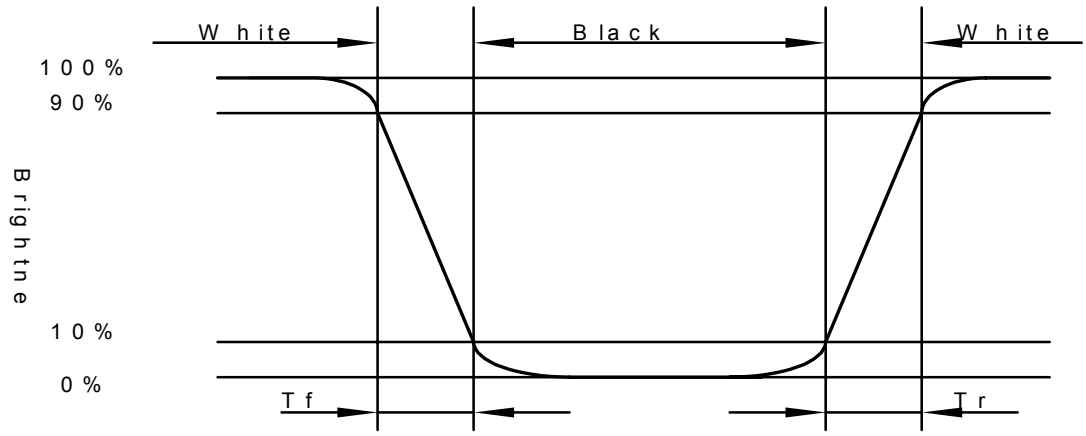
The test configurations of contrast ratio see section 8-2 .

Note 8-2 :1.Topcon BM-7(fast) luminance meter 1.0° field of view is used in the testing (after 20~30 minutes operation).
2. Lamp current 3mA.

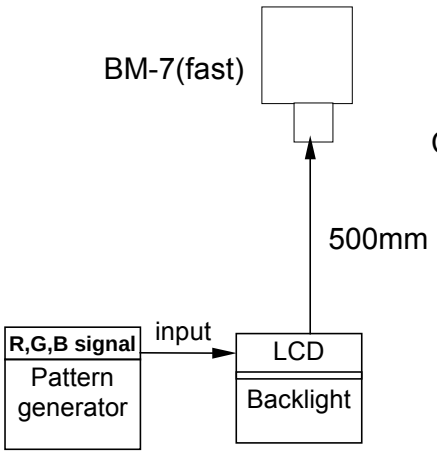
Note 8-3 : The definitions of viewing angles diagrams:



Note 8-4: The definition of response time:

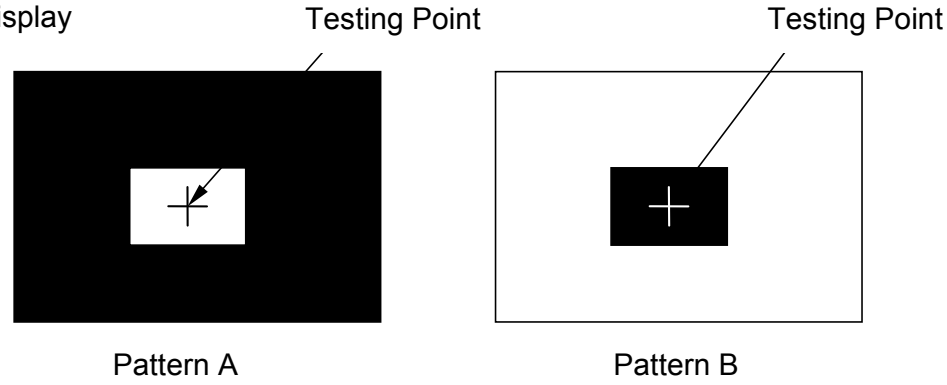


8-2. Testing configuration



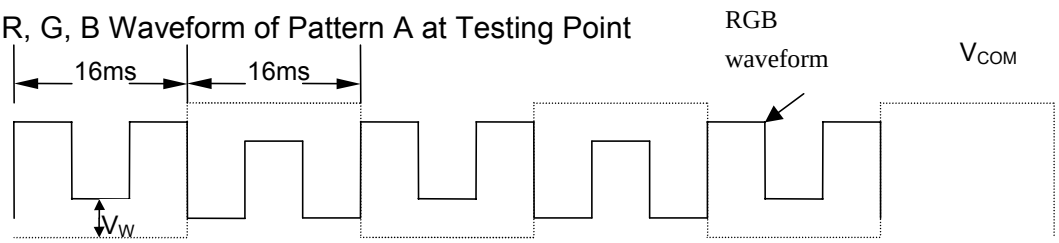
Caution: 1. Environmental illumination≦1 lux
2. Before test CR, Vcom voltage must be adjusted carefully to get the best CR.

- LCD Display



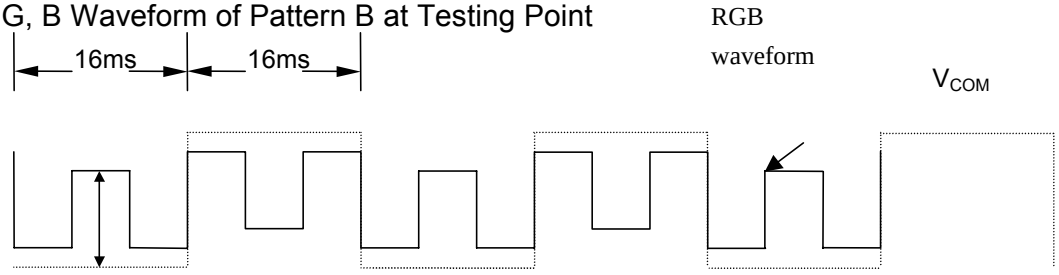
Pattern A Pattern B

- R, G, B Waveform of Pattern A at Testing Point



V_W=1.1V +/- 0.2V

- G, B Waveform of Pattern B at Testing Point



V_b=5.2V +/-0.2V

9. Input / Output Terminals

9.1 PIN Connections

Pin No	Symbol	I/O	Description	Remark
1	STH1	I/O	Start Pulse for Source Driver	Note 9-1
2	AV_{SS}	I	Analog GND for Source Driver	
3	AV_{DD}	I	Analog Power Input for Source Driver	Note 9-2
4	V_B	I	Video Input B	Note 9-4
5	V_G	I	Video Input G	Note 9-4
6	V_R	I	Video Input R	Note 9-4
7	V_{SS}	I	Digital Ground	
8	V_{DD}	I	Digital Power Input	Note 9-3
9	CPH1	I	Sampling and Shift Clock for Source Driver	
10	CPH2	I	Sampling and Shift Clock for Source Driver	
11	CPH3	I	Sampling and Shift Clock for Source Driver	
12	STH2	I/O	Start Pulse for Source Driver	Note 9-1
13	Q2H	I	Video Input Rotation Control	
14	INH	I	Output Enable for Source Driver	
15	R/L	I	Left / Right for Source Driver	Note 9-1
16	V_{COM}	I	Common Electrode Voltage	Note 9-4
17	V_{COM}	I	Common Electrode Voltage	Note 9-4
18	XOE	I	Output Enable for Gate Driver	
19	CPV	I	Clock input for gate driver	
20	U/D	I	Up / Down Control for Gate Driver	
21	DIO2	I	Vertical Start Pulse	Note 9-5
22	DIO1	I	Vertical Start Pulse	Note 9-5
23	V_{GL}	I	Gate off Voltage (Alternative Every 1-H)	Note 9-4
24	V_{EE}	I	Gate Driver Negative Voltage	Note 9-6
25	V_{SS}	I	GND	
26	V_{CC}	I	Logic Power for Gate Driver	Note 9-3
27	V_{GH}	I	Gate on Voltage	Note 9-7
28	NC	-	No Connection	

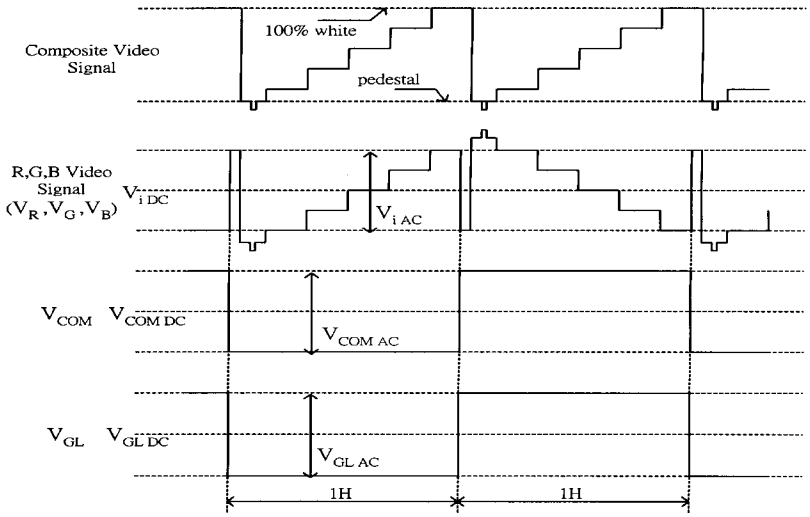
A: LCD FFC Down connector, 28 pin pitch 0.5mm
B: Backlight connector JST BHR-03VS-1, 3 pin pitch 4mm

Note 9-1: STH1,STH2,and R/L mode

R/L	STH1	STH2	Remark
Hi(VDD)	Input	Output	Left to Right
Low(0 Volt.)	Output	Input	Right to Left

Note 9-2: AV_{DD} = +5V (Typ.)
Note 9-3: V_{DD} , V_{CC} = +5V (Typ.)
Note 9-4 : V_{COM} =6V_{PP}.

Phase of the video signal input and V_{COM}
The relation between these values could refer to Operating condition.



Liquid crystal transmission of the video signal input, V_{COM} and timing

	V_{COM}	
	H Level	L level
Video Signal input Maximum	Black	White
Video Signal input Minimum	White	Black

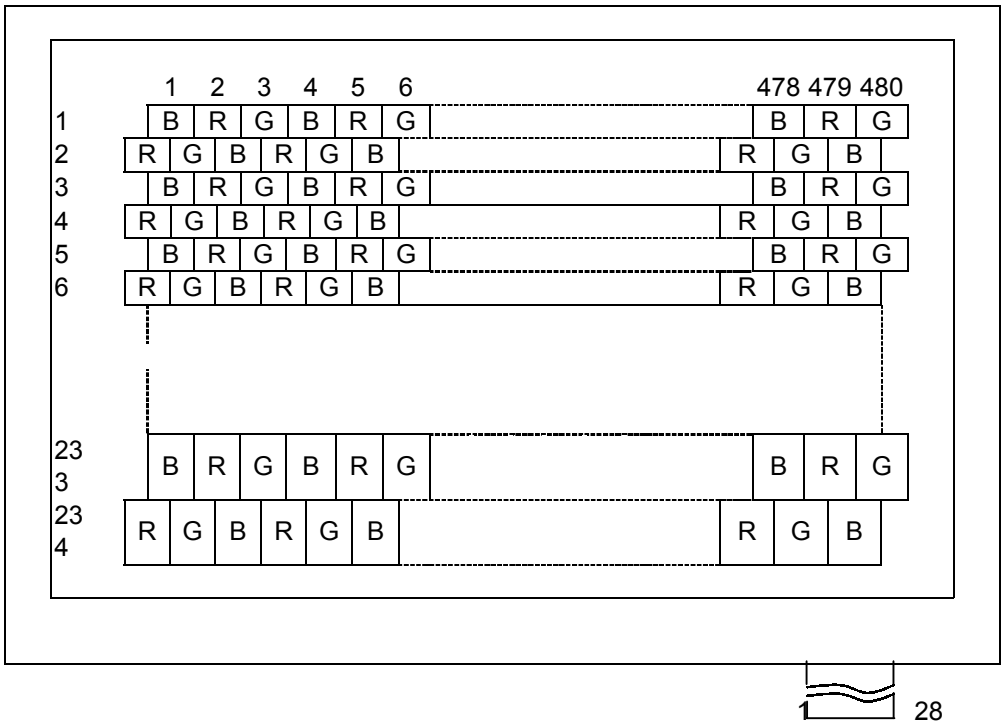
White: maximum transmission / Black: minimum transmission

Note 9-5 : DIO1,DIO2 and U/D mode

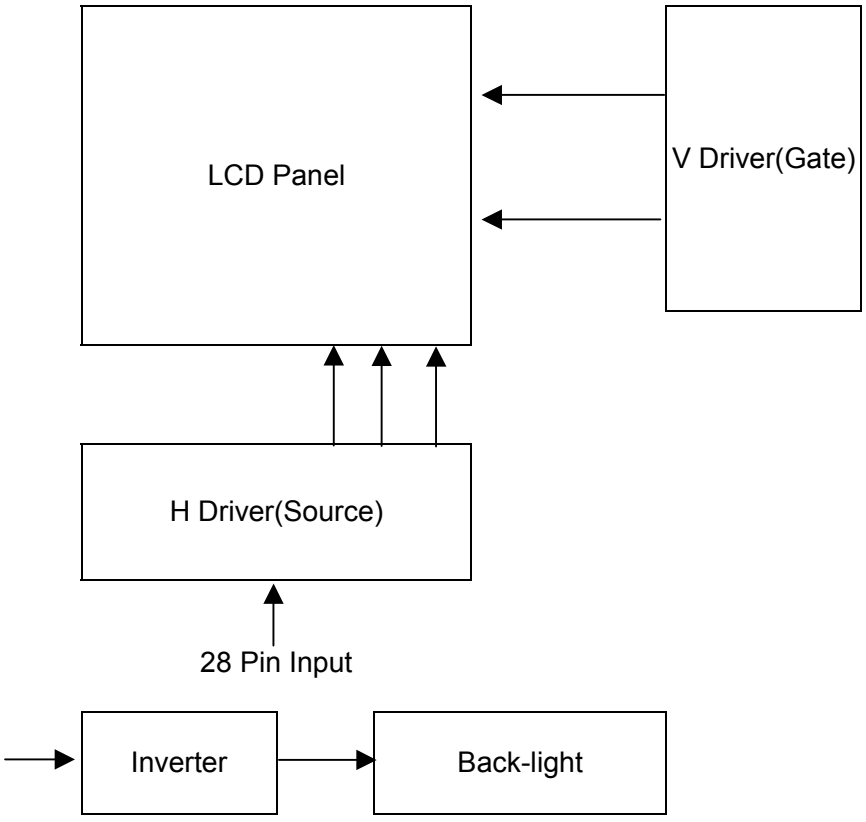
U/D	DIO1	DIO2	Remark
Hi(VDD)	Input	Output	Down to Up
Low(0 Volt.)	Output	Input	Up to Down

Note 9-6 : V_{EE} = -15V (Typ.)
Note 9-7 : V_{GH} = +15V (Typ.)

9.2 Pixel Arrangement and input connector pin NO.



10. Block Diagram



11. QUALITY ASSURANCE

Test Condition

11.1.1 Temperature and Humidity(Ambient Temperature)

Temperature : 20 ± 5°C

Humidity : 65 ± 5%

11.1.2 Operation

Unless specified otherwise, test will be conducted under function state.

11.1.3 Container

Unless specified otherwise, vibration test will be conducted to the product itself without putting it in a container.

11.1.4 Test Frequency

In case of related to deterioration such as shock test. It will be conducted only once.

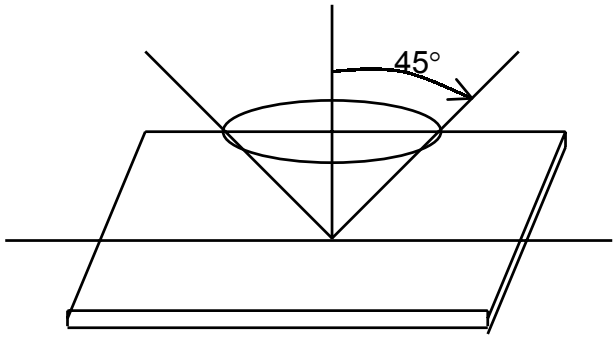
11.1.5 Test Method

No.	Reliability Test Item & Level	Test Level
1	High Temperature Storage Test	T=70°C,240hrs
2	Low Temperature Storage Test	T=-20°C,240hrs
3	High Temperature Operation Test	T=60°C,240hrs
4	Low Temperature Operation Test	T=0°C,240hrs
5	High Temperature and High Humidity Operation Test	T=60°C,95% RH,240hrs
6	Thermal Cycling Test (No operation)	-20°C → +25°C → +70°C,200 Cycles 30 min 5min 30 min
7	Vibration Test (No operation)	Frequency:10 ~ 55 Hz Amplitude:1.0 mm Sweep Time:11min Test Period:6 Cycles for each Direction of X,Y,Z
8	Shock Test (No operation)	100G, 6ms Direction：± X,± Y,± Z Cycle：3 times
9	Electrostatic Discharge Test (No operation)	150pF,330Ω Air:± 15KV;Contact: ± 8KV 10 times/point;4 points/panel face

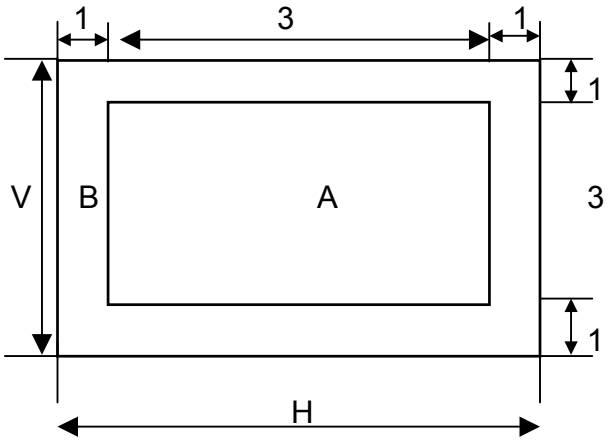
11.2 Inspection condition

11.2.1 Inspection conditions

The LCD shall be inspected under 40W white fluorescent light.
θ<45° inspection under non-operating condition.
θ<5° inspection under operating condition.



11.2.2 Definition of applicable Zones



11.2.3 Inspection Parameters

<table>
<tr><th>No.</th><th>Parameter</th><th>Criteria</th></tr>
<tr><td rowspan="4">1</td><td rowspan="4">Operating</td><td>Display function: No Display malfunction (Major)</td></tr>
<tr><td>Contrast ratio (Black, White) :
Does not meet specified range in the spec. (Major) (Note:3)</td></tr>
<tr><td>Line Defect: No obvious Vertical and Horizontal line defect in bright, dark and colored. (Major)</td></tr>
<tr><td>Point Defect (red, green, blue, dark): Active area ≤ 6dots(Minor) (Note: 1,4)
<table>
<tr><th rowspan="2">Item</th><th colspan="2">Acceptable number</th><th rowspan="2">Total</th></tr>
<tr><th>A</th><th>B</th></tr>
<tr><td>Bright</td><td>0</td><td>2</td><td rowspan="3">6</td></tr>
<tr><td>Dark</td><td>2</td><td>4</td></tr>
<tr><td>Total</td><td>2</td><td>5</td></tr>
</table>
</td></tr>
<tr><td rowspan="2">2</td><td rowspan="2">External Inspection
(non-operating)</td><td>Non-uniformity: Visible through 2%ND filter. (Major)</td></tr>
<tr><td>Dimension: Outline (Major)
Scratch on the polarizer: (Note:2)
<table>
<tr><th>X (mm) \ Zone Y(mm)</th><th>Acceptable number</th><th>Class Of Defects</th><th>AQL Level</th></tr>
<tr><td>L≦2</td><td>W≦0.1</td><td>3</td><td rowspan="2">Minor</td><td rowspan="2">1.5</td></tr>
<tr><td>L>2</td><td>W>0.1</td><td>0</td></tr>
</table>
X : Length Y : Width
Dent or bubble on the polarizer (Note:2)
<table>
<tr><th>X (mm) \ Zone Y(mm)</th><th>Acceptable number</th><th>Class Of Defects</th><th>AQL Level</th></tr>
<tr><td></td><td>D≦0.3</td><td>3</td><td rowspan="2">Minor</td><td rowspan="2">1.5</td></tr>
<tr><td></td><td>D≦0.05</td><td>*</td></tr>
</table>
Foreign material on the polarizer (Note:2)
<table>
<tr><th>X (mm) \ Zone Y(mm)</th><th>Acceptable number</th><th>Class Of Defects</th><th>AQL Level</th></tr>
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<tr><td></td><td>D≦0.1</td><td>*</td></tr>
</table>
* : Disregard</td></tr>
<tr><td></td><td>External Inspection
(non-operating)</td><td>Wrinkle on polarize: Serious wrinkle is not allowed</td></tr>
</table>

Remark: Major: Defect that is likely to result in failure or to reduce materially the usability of the product for the intended function.
Minor: Defect that will not result in functioning problem with deviation classified.

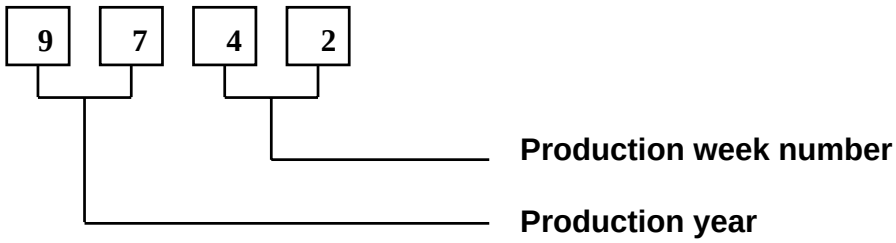
Note:1.(a)Distance between point defect distance should be large than 5 mm. The ambient illumination level is 100~150 lux.

Note:2 The external inspection should be conducted at the distance 35± 5cm between the eyes of inspector and the panel .The inspection area is defined as full screen.

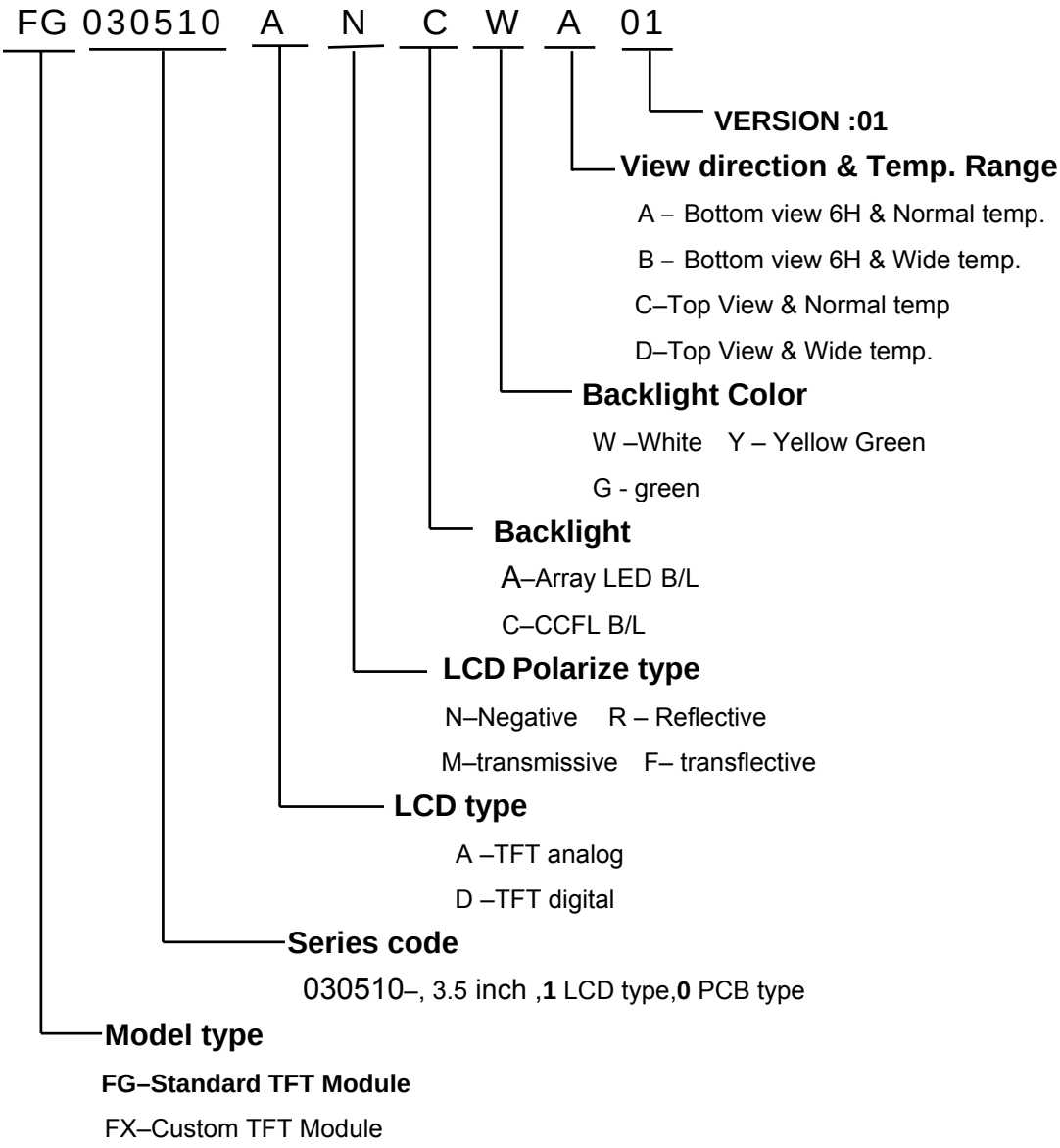
Note:3 Luminance measurement for contrast ratio is at the distance 50± 5cm between the detective head and the panel . With ambient illuminance less than 1 lux. Contrast ratio is obtained at optimum view angle.

Note:4 Coupling of one dark and one bright point in junction is counted as one dark and bright spot.Two dark spot in adjacent is counted as two dark points.

12. LOT NUMBERING SYSTEM



13. LCM NUMBERING SYSTEM



14. PRECAUTION FOR USING LCM

1. LIQUID CRYSTAL DISPLAY (LCD)

LCD is made up of glass, organic sealant, organic fluid, and polymer based polarizers. The following precautions should be taken when handing,

(1). Keep the temperature within range of use and storage. Excessive temperature and humidity could cause polarization degredation, polarizer peel off or bubble.

(2). Do not contact the exposed polarizers with anything harder than an HB pencil lead. To clean dust off the display surface, wipe gently with cotton, chamois or other soft material soaked in petroleum benzin.

(3). Wipe off saliva or water drops immediately. Contact with water over a long period of time may cause polarizer deformation or color fading, while an active LCD with water condensation on its surface will cause corrosion of ITO electrodes.

(4). Glass can be easily chipped or cracked from rough handling, especially at corners and edges.

(5). Do not drive LCD with DC voltage.

2. Liquid Crystal Display Modules

2.1 Mechanical Considerations

LCM are assembled and adjusted with a high degree of precision. Avoid excessive shocks and do not make any alterations or modifications. The following should be noted.

(1). Do not tamper in any way with the tabs on the metal frame.

(2). Do not modify the PCB by drilling extra holes, changing its outline, moving its components or modifying its pattern.

(3). Do not touch the elastomer connector, especially insert an backlight panel (for example, EL).

(4). 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.

(5). Avoid pressing on the metal bezel, otherwise the elastomer connector could be deformed and lose contact, resulting in missing pixels.

2.2. Static Electricity

LCM contains CMOS LSI's and the same precaution for such devices should apply, namely

(1). The operator should be grounded whenever he/she comes into contact with the module. Never 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.

(2). The modules should be kept in antistatic bags or other containers resistant to static for storage.

(3). Only properly grounded soldering irons should be used.

(4). If an electric screwdriver is used, it should be well grounded and shielded from commutator sparks.

(5) The normal static prevention measures should be observed for work clothes and working benches; for the latter conductive (rubber) mat is recommended.

(6). Since dry air is inductive to statics, a relative humidity of 50-60% is recommended.

2.3 Soldering

(1). Solder only to the I/O terminals.

(2). Use only soldering irons with proper grounding and no leakage.

(3). Soldering temperature : 280°C ± 10°C

(4). Soldering time: 3 to 4 sec.

(5). Use eutectic solder with resin flux fill.

(6). If flux is used, the LCD surface should be covered to avoid flux spatters. Flux residue should be removed after wards.

2.4 Operation

(1). The viewing angle can be adjusted by varying the LCD driving voltage V0.

(2). Driving voltage should be kept within specified range; excess voltage shortens display life.

(3). Response time increases with decrease in temperature.

(4). Display may turn black or dark blue at temperatures above its operational range; this is (however not pressing on the viewing area) may cause the segments to appear "fractured".

(5). Mechanical disturbance during operation (such as pressing on the viewing area) may cause the segments to appear "fractured".

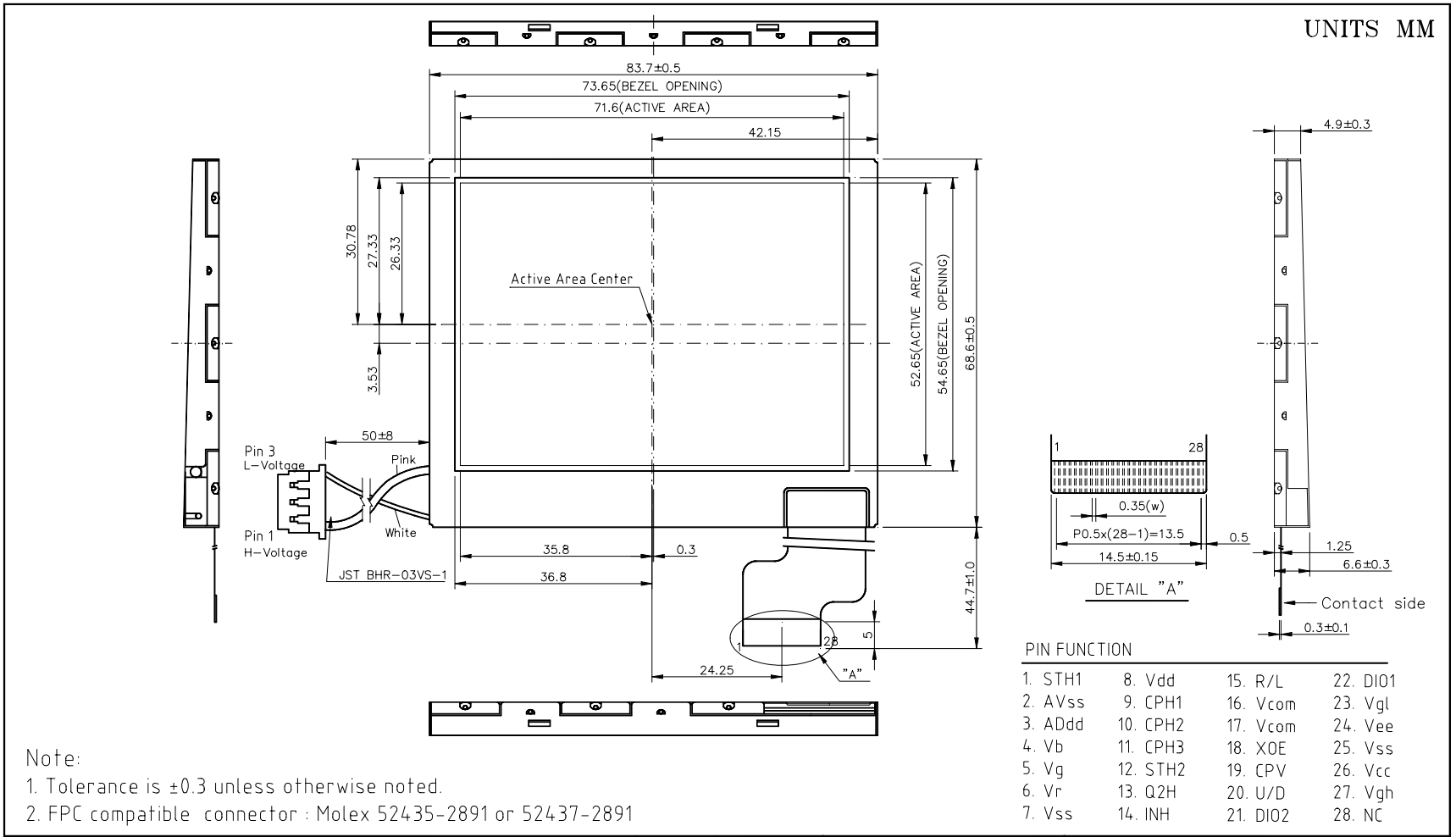
2.5 Storage

If any fluid leaks out of a damaged glass cell, wash off any human part that comes into contact with soap and water. Never swallow the fluid. The toxicity is extremely low but caution should be exercised at all the time.

2.6 Limited Warranty

Unless otherwise agreed between Company and customer, Company will replace or repair any of its LCD and LCM which is found to be defective electrically and visually when inspected in accordance with Company acceptance standards, for a period on one year from date of shipment. Confirmation of such date shall be based on freight documents. The warranty liability of Company is limited to repair and/or replacement on the terms set forth above. Company will not responsible for any subsequent or consequential events.

15. OUTLINE DRAWING



Note:
1. Tolerance is ±0.3 unless otherwise noted.
2. FPC compatible connector : Molex 52435-2891 or 52437-2891

PIN FUNCTION

1. STH1	8. Vdd	15. R/L	22. DIO1
2. AVss	9. CPH1	16. Vcom	23. Vgl
3. ADdd	10. CPH2	17. Vcom	24. Vee
4. Vb	11. CPH3	18. XOE	25. Vss
5. Vg	12. STH2	19. CPV	26. Vcc
6. Vr	13. Q2H	20. U/D	27. Vgh
7. Vss	14. INH	21. DIO2	28. NC

16.PACKAGE INFORMATION