

# SPECIFICATION

Model : TFT LCD MODULE LTA070B410A-351

Customer :

AV- USE Marketing&Engineering Dept.					ISSUE DATE
Customer	ESIT	Design	Production	Sales	

Model : LTA070B410A-351





## Caution and Handling Precaution

For your end user's safety, it is strongly advised that the items with "\*" should be included in the instruction manual of the system which may be issued by your organization.

### For Safety



#### Warning

- (1) This Standard LCD modules have not been customized for operation in extreme environments or for use in applications where performance failures could be life-threatening or otherwise catastrophic.  
Since they must never be installed in aircraft navigation control systems (such as, but not limited to Traffic Collision System and Air Traffic Indicator), in military defense or weapons systems, in critical industrial process-control systems (e.g., those involved in the production of nuclear energy), or in critical medical device or patient life-support systems.



#### Caution

- (1) DO NOT DISASSEMBLE OR MODIFY the module.  
Sensitive parts inside LCD module may be damaged, and dusts or scratches may mar the displays. SVIT does not warrant the module, if customer disassembled or modified them.
- \*(2) DO NOT INGEST liquid crystal material, DO NOT INHALE this material, and DO NOT PERMIT this material to contact the skin, if glass of LCD panel is broken and liquid crystal material spills out. If liquid crystal material contacts the skin, mouth or clothing, take the following actions immediately.  
In case contact to the eye or mouth, rise with large amount of running water for more than 15 minutes.  
In case contact to the skin or clothing, wipe it off immediately and wash with soap and large amount of running water for more than 15 minutes. The skin or clothing may be damaged if liquid crystal material left adhered.  
In case ingestion, rise out the mouth well with water. After spewing up by drinking large amount of water, get medical.
- \*(3) BE CAREFUL WITH CHIPS OF GLASS that may cause injuring fingers or skin, when the glass is broken. Since FL is also made of glass, when FL is built in, handle with due care as well.
- (4) DO NOT EXCEED the absolute maximum rating values under the worst probable conditions caused by the supply voltage variation, input voltage variation, variation in parts constants, ambient temperature, etc., otherwise LCD module may be damaged.
- (5) Suitable protection circuit should be applied for each system design.  
DO NOT MODIFY the fuse used in the module. It may cause overheat and/or burning if dusts or metal particles are on the PCBs in the LCD module.

- (6) Be sure that power supply output from the system should be limited to smaller values than listed shown below.

It is because this LCD module explained in this specification has a current limiter, with such function at power input lines. But it may be some possibility of overheat and/or burning of LCD module and its peripheral devices before current limiter of the module when open-short test of the module is performed by using power supply higher than following recommended value.

Power supply	Recommended maximum output current of power supply
V <sub>DD1</sub>	≤ 0.5A
V <sub>DD2</sub>	≤ 1.0A
V <sub>GH</sub>	≤ 0.5A
V <sub>GL</sub>	≤ 0.5A

- (7) Always comply all applicable environmental regulations, when disposing of LCD module.

## For Designing the System

### DESIGNING ENCLOSURE

- (1) When including a module in a set, Please fix the outside of the active area of array glass or a polarizing plate on a double-sided tape etc., and confirm the intensity of set.  
Be careful so that direct pressurization does not start a cell.

### DESIGNING POWER SUPPLIES AND INPUT SIGNALS TO LCD MODULE

- (2) Power supply lines should be designed as follows.  
Power supplies should always be turned on before the input signals are supplied to LCD module, and the input signals should be disconnected before power supplies are turned off.

### DESIGNING FOR BETTER VISIBILITY

- (3) In case of severe environmental condition like outdoor usage, a proper transparent protective cover over LCD module is recommended to apply in order to prevent scratches, and invasion of dusts, water, etc., from the system's window onto LCD module.  
Ultra-violet ray cut filter is recommended to apply onto LCD module for outdoor operation. Strong ultra-violet ray may cause damage the panel. However, in that case, transmittance-luminance will decrease. Careful selection of material is required.

## For Installation in Assembly

### ESD(ELECTRO-STATIC DISCHARGE)PREVENTION

- (1) The C-MOS LSIs used in LCD module are very sensitive to ESD (electro-static Discharge). Ambient humidity of working area is recommended to be higher than 50%RH.  
Person handling LCD modules should be grounded with wrist band. Tools like soldering iron and screw driver, and working benches should be grounded.  
The grounding should be done through a resistor of 0.5-1M ohms in order to prevent spark of ESD.
- (2) When remove protection film from LCD panel, peel off the film slowly (more than three seconds) from the edge of the panel, using a soft-pointed tweezers covered by teflon or adherent tape.



#### DUST AND STAIN PREVENTION

- (3) Reduce dust level in working area. Especially the level of metal particle should be decreased.  
Use finger stalls or soft and dust-free gloves in order to keep clean appearance of LCD module when handled for incoming inspection and assembly.
- \* (4) When LCD panel becomes dirty, wipe off the panel surface softly with absorbent cotton or another soft cloth.  
If necessary, breathe upon the panel surface and then wipe off immediately and softly again.  
If the dirt can not be wiped off, follow the instructions described in individual specification.  
Be careful not to spill organic solvents into the inside of LCD module. The solvents may damage driver IC and PCB area used inside module. The polarizer laminated to LCD panel and adhesives may be damaged by the solvents, so do not use any organic solvents for wiping off LCD panel.
- \* (5) AVOID THE DEWING OF WATER CONDENSATION.  
Wipe off a spot or spots of water or mist on LCD panel softly with absorbent cotton or another cloth as soon as possible if happened, otherwise discoloration or stain may be caused. If water invade into LCD module, it may cause LCD module damages.

#### BENDING / TWISTING OF LCD MODULE DURING ASSEMBLY

- \* (6) DO NOT APPLY MECHANICAL FORCES.  
Do not bend or twist LCD module even momentarily when LCD module is installed in enclosure of the system. Bending or twisting LCD module may cause its damages. Make sure to design the enclosure that bending/twisting forces are not applied to LCD module when it is installed in the system.  
Refrain from strong mechanical shock like dropping from the working bench or knocking against hard object. These may cause the panel crack, damage of FL or other mis-operation.

#### MECHANICAL FORCES

- \* (7) Refrain from excessive force like pushing the surface of LCD panel. This may cause scratches or breakage of the panel, or a failure of the module.
- \* (8) Do not put heavy object such as tools, books, etc., and do not pile up LCD modules.  
Be careful not to touch surface of the polarizer laminated to the panel with any hard and sharp object. The polarizer is so soft that it can be easily scratched, even the protect film covers it.
- (9) When inserting or disconnecting the connectors to LCD module, be sure not to apply force against PCB, not connecting cables, otherwise internal connection of PCB may be damaged.

#### OPERATION

- (10) Power supplies should always be turned off in assembling process.  
Do not connect or disconnect the power cables and connectors with power applied to LCD module. This may cause damage of module circuit.  
The signal should be applied after power supplies are turned on. And the signal should be removed before power supplies are turned off.

## For Transportation and Storage

- (1) Do not store LCD module in high temperature, especially in high humidity for a long time approximately more than one month).

It is recommended to store LCD module where the temperature is in the range of 0 to 35 degrees Celsius and the relative humidity is lower than 70%.

- (2) Low temperature

Liquis crystal material may be coagulates and LCD panel may be damaged at the lower temperature than storage teperature range described in individual specification.

- (3) Store LCD module without exposure to direct sunlight or fluorescent lamps in order to prevent the module from strong ultra violet ray.

- \* (4) Avoid condensation of water on LCD module, otherwise it may cause mis-operation or defects.  
Keep away LCD module from such ambient.

- (5) In case of transportation of storage after opening the original packing. LCD module are recommended to be repacked into the original packaging with the same method, especially with same kind of desiccant.



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## 1. Scope

This draft specification is applicable to this Full Color TFT-LCD module "LTA070B410A-351" designed for Portable DVD and TV monitor use.

## 2. Specifications

## 2.1 General specifications

Items	Specifications	Note
Screen size	18cm (7.0-inch) diagonal screen	
Display mode	TN full color, Transmissive type	Normally white
Contents	a-Si TFT active matrix panel Line sequential scanning Non-Interface drive	
Input signal	Sync.	Horizontal/Vertical start puls and clock
	Signal	Specified analog RGB signals (H-line alternate signal)
	Common	H-line alternate signal
Dimensional outline	163.08(W) x 97.65(H) x 1.9(D) max.	[unit:mm]
Active area	154.08(W) x 87.048(H)	[unit:mm]
Pixel arrangement	RGB stripe	Note 1
Number of pixels	480(W) x 234(H)	Note 1
Number of sub-pixels	1440(W) x 234(H)	Note 1
Pixel pitch	0.3210(W) x 0.3720(H)	[unit:mm]
Viewing direction	6 o'clock (in direction of maximum CR)	Refer to figure A (Next sheet)
Weight	865g(typ.)	g
Surface treatment	Anti-glare coating on LCD panel surface. wide view film	

Note 1: Pixel arrangement

	1	2	3	4	5		1437	1438	1439	1440
1	R	G	B	R	G		B	R	G	B
2	R	G	B	R	G		B	R	G	B
233	R	G	B	R	G		B	R	G	B
234	R	G	B	R	G		B	R	G	B

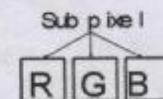
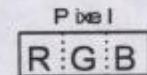
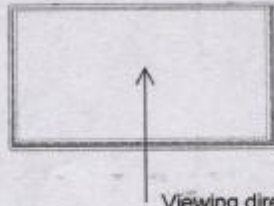


Figure A: Viewing direction



Viewing direction: 6 o'clock (Max. contrast ratio)

This product be used as 12 o'clock viewing direction by setting LCD module upside down, and switching scanning direction.

## 2.2 Absolute maximum ratings

Items	Symbol	Conditions	Absolute maximum ratings		Unit	Remarks
			Min.	Max.		
Supply Voltage	$V_{DD1}, V_{DD2}$	$T_a = 25 \pm 5^\circ\text{C}$	-0.3	6.5	V	
	$V_{GH}$		15.0	29.0	V	
	$V_{GL}$		-17.0	$V_{SS}$	V	
	$V_{GH} - V_{GL}$		15.0	45.0	V	
Input signal voltage	Video	$V_{SS} = 0\text{V}$	$V_{SS} + 0.2$	$V_{DD2} - 0.3$	V	
	Sync.		$V_{SS} - 0.3$	$V_{DD1} + 0.3$	V	
	Common		-10.0	13.0	V	
Operating temperature	$T_{op}$	—	-30	85	$^\circ\text{C}$	Note 2,3
Storage temperature	$T_{stg}$	—	-40	85	$^\circ\text{C}$	Note 2

Note 1 : Do not exceed the maximum rating values under the worst probable conditions taking into account the supply voltage variation, input voltage variation, variation in part constants, and ambient temperature and so on. Otherwise the module may be damaged.

Note 2 : The temperature on TFT-LCD panel surface.

Note 3 : The temperature of the module rises under the influence of the backlight.

Please design that all parts fo this module does not to exceed 85°

Note 4 : Operation time < 15min. Screen quality should not have distinguished unevenness.

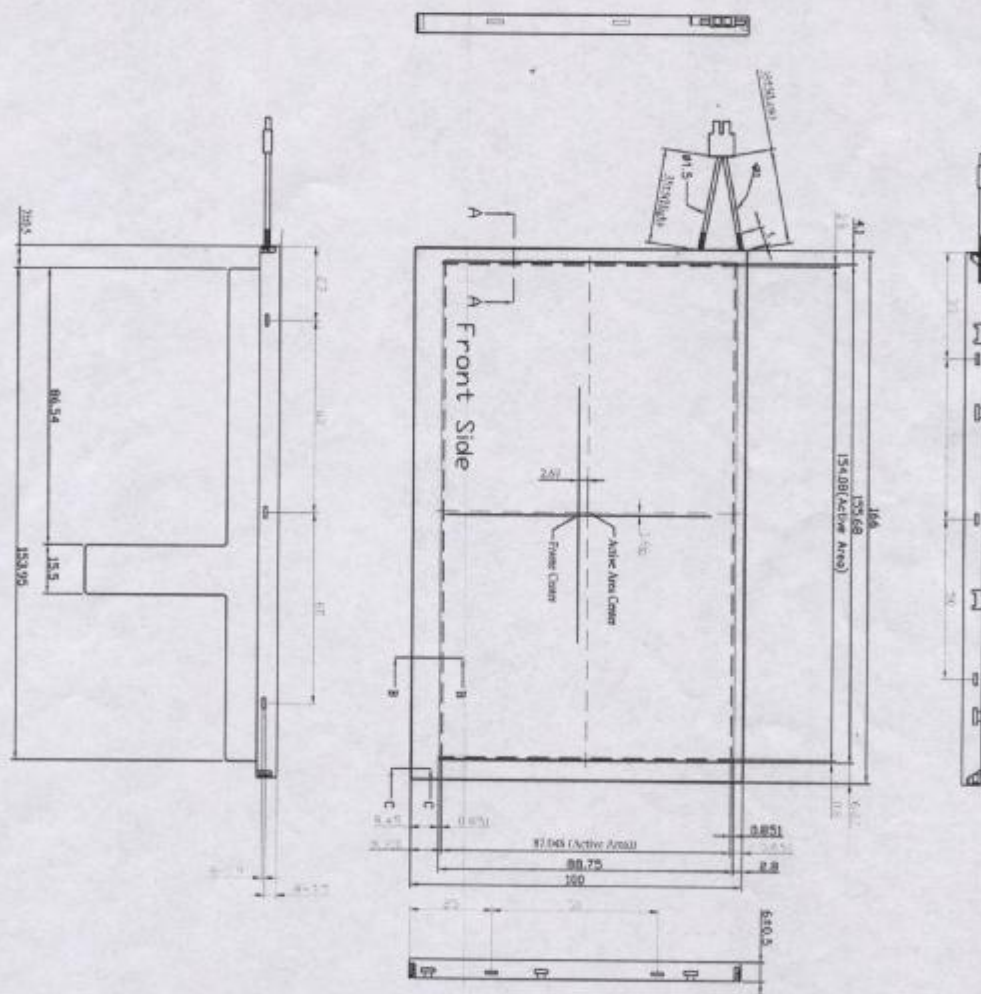
## 2.3 Mechanical specifications

2.3.1 Weight: 865g (typ.)

2.3.2 Dimensional outline and label indication

(a) Dimensional outline (Front view)

Unit : mm

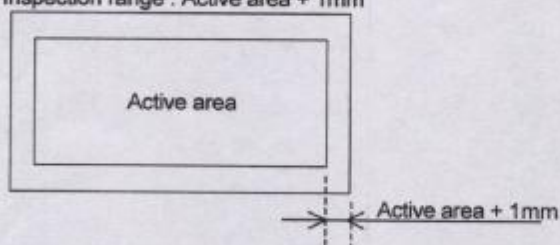




### 2.3.3 Appearance

Inspection parts	Items		Standard	Remarks
Cell	Front side scratch	Line	Line width (mm)	Acceptable count / length
			$W < 0.05$	neglect
			$0.05 \leq W < 0.15$	total length $\leq 50\text{mm}$
			$0.15 \leq W$	NG
		Spot	Size (sub pixel)	Judgement
			$D < 1$	neglect
			$1 \leq D < 3$	1 dark sub pixel
			$3 \leq D$	NG
	Rear side scratch		Same as front scratch standard. (Condition : front view)	
	Flaw		Display of the module should be maintained.	
	Dirt		No dirt which can not be cleaned easily.	
	Discoloration		No conspicuous discoloration.	
Interface connector	Scratch		No scratch.	
	Distortion		No distortion.	

Note 1 : Inspection range : Active area + 1mm



## 2.4 Interface

[CN1] LCD FPC Cable : (0.5pitch,30pin)

No.	Symbol	Functions	I/O	Remarks
1	NC	No Connect	-	
2	V <sub>GL</sub>	Input power supply -12.0V	Input	Note 1
3	NC	No Connect	-	
4	V <sub>SS</sub>	Ground (0V)	-	
5	STV1	Vertical start pulse 1	Input	Note 2
6	U/D	Scanning direction switch	Input	Note 2
7	CPV	Vertical clock pulse	Input	Note 2
8	OE3	Vertical(gate) enable 3	Input	Note 2
9	OE2	Vertical(gate) enable 2	Input	Note 2
10	OE1	Vertical(gate) enable 1	Input	Note 2
11	STV2	Vertical start pulse 2	Input	Note 2
12	VDD1	Power Supply +3.3V	Input	Note 1
13	VDD2	Power Supply +5.0V	Input	Note 1
14	NC	No Connect	-	
15	V <sub>GH</sub>	Input power supply 18.5V	Input	Note 1
16	NC	No Connect	-	
17	Vcom	Common voltage	Input	Note 2
18	VSS	Ground (0V)	-	
19	VSS	Ground (0V)	-	
20	CPH	Horizontal clock pulse	Input	Note 2
21	VSS	Ground (0V)	-	
22	CX	Column driver latch channel control	Input	Note 2
23	L/R	Scanning direction switch	Input	Note 2,3
24	STH1	Horizontal start pulse 1	Input	Note 2,3
25	VSS	Ground (0V)	-	
26	VB	Video input B	Input	Note 2
27	VG	Video input G	Input	Note 2
28	VR	Video input R	Input	Note 2
29	STH2	Horizontal start pulse 2	Input	Note 2,3
30	NC	No Connect	-	

Note 1 : Power supply sequence

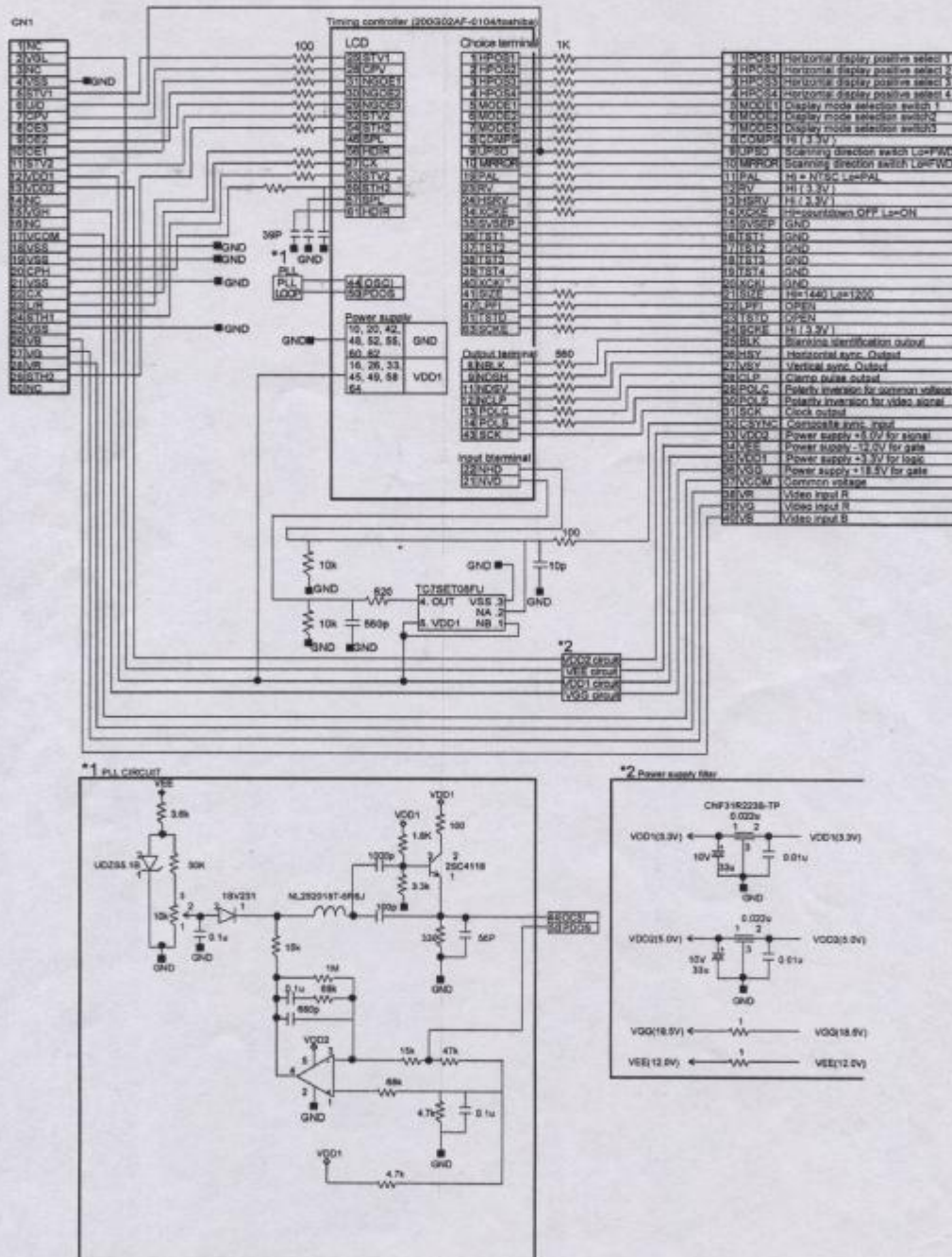
Power ON	V <sub>DD1</sub> → V <sub>GL</sub> → V <sub>DD2</sub> → V <sub>GH</sub>
Power OFF	V <sub>GH</sub> → V <sub>DD2</sub> → V <sub>GL</sub> → V <sub>DD1</sub>

Note 2 : Refer to "2.6.2 Indication Timing diagram "

Note 3 : U/D(pin 6)=Lo , STV1(pin 10)=input , STV2(pin 4)=opening  
 L/R(pin 23)=Lo , STH1(pin 17)=input , STH2(pin 33)=opening

## 2.5 Application

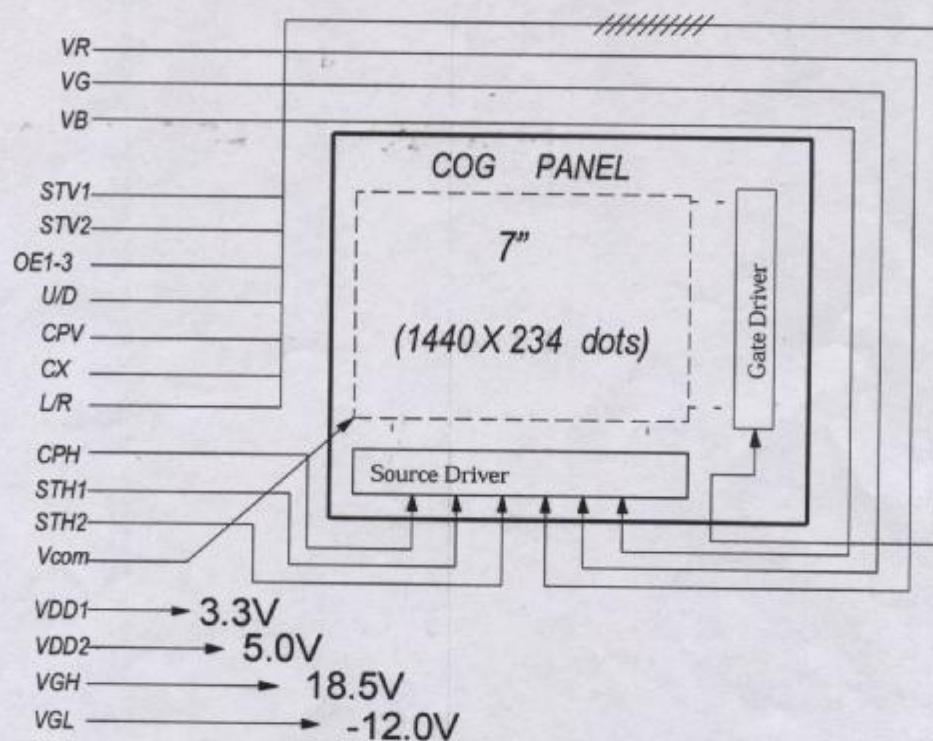
Connection between this module and timing controller is recommended as follows.



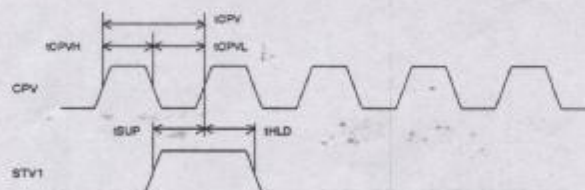


## 2.6 Electrical specifications

### 2.6.1 Circuit block diagram



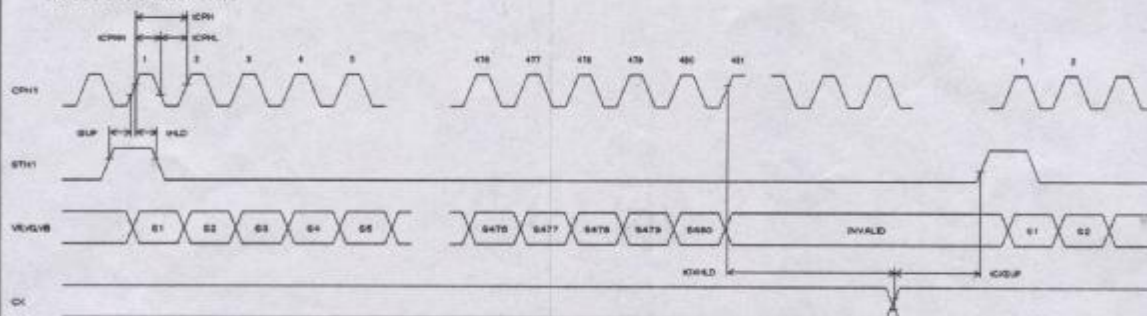
## 2.6.2 Indication Timing diagram vertical timing



## 2.6.3 horizontal timing diagram

### synchronous sampling

<同時サンプリング (MODE = Hi)>

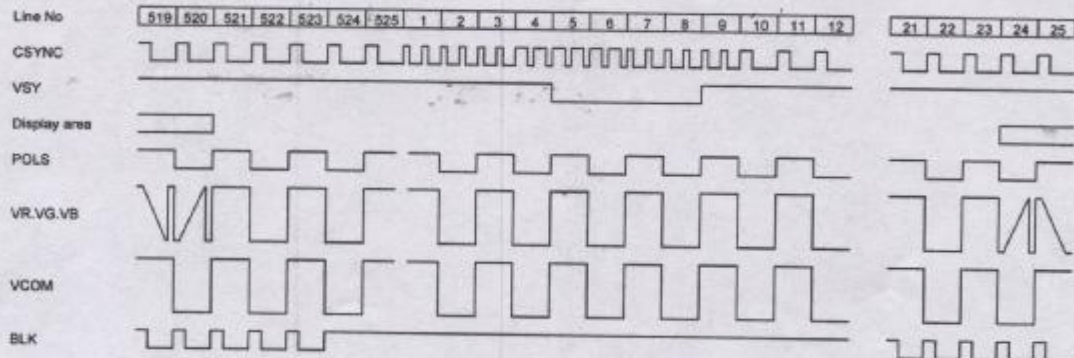


Indication timing diagram  
<Vertical> (NTSC)

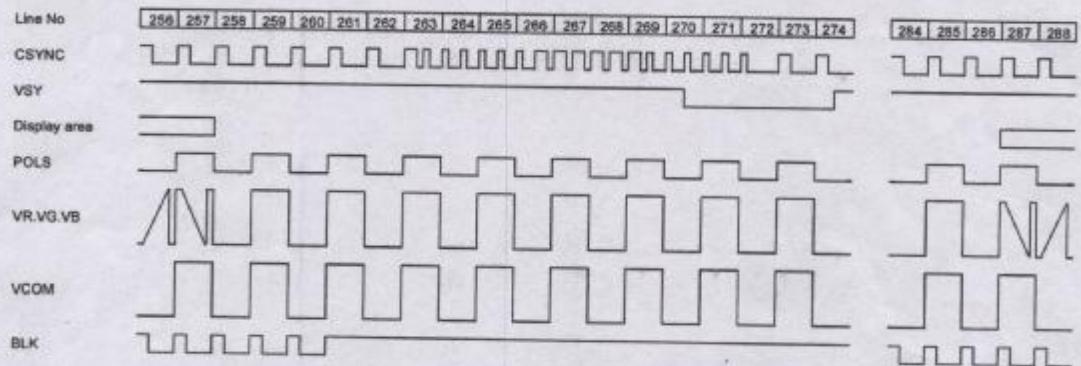
Timing example for use timing controller[TC200G02AF-0104(TOSHIBA)]

**NTSC**

ODD FIELD



EVEN FIELD



Display differs by a selection of display mode. (Refer to Right table)  
An aforementioned timing chart shows display position around FULL-MODE

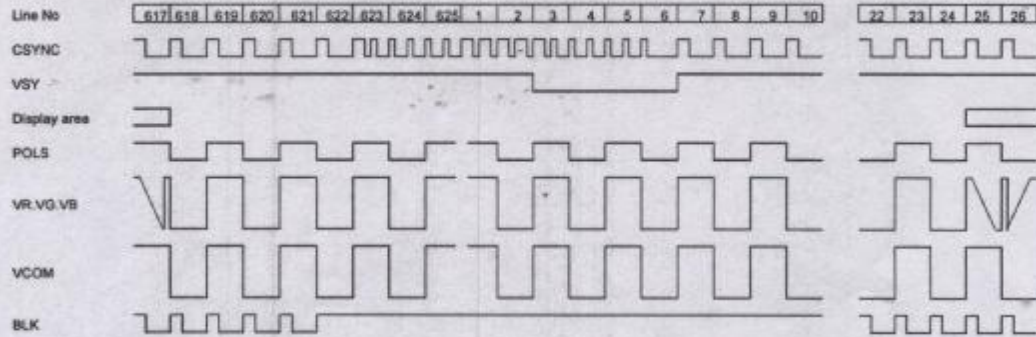
Display Mode	Display period (Line No.)	
	ODD	EVEN
FULL		
NORMAL-CENTER		
NORMAL-LEFT	24-257	287-520
NORMAL-RIGHT		
WIDE		
ZOOM1	53-228	318-491
ZOOM2	39-242	302-505
ZOOM3	54-257	318-520



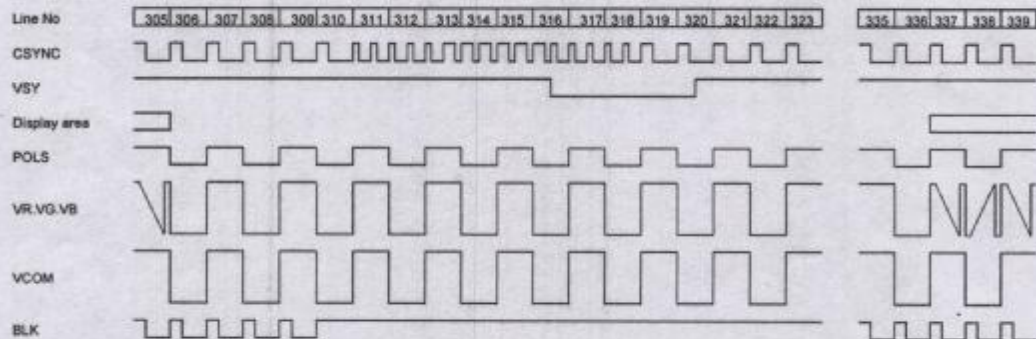
<Vertical> (PAL)

PAL

ODD FIELD



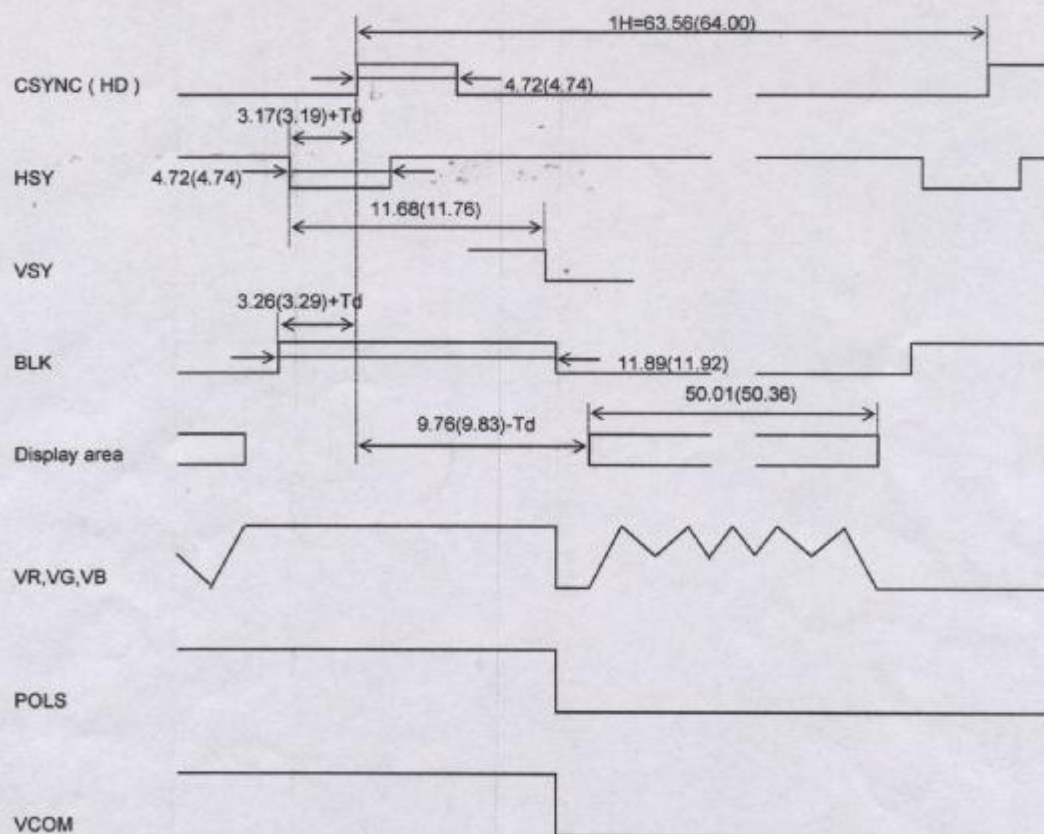
EVEN FIELD



Display differs by a selection of display mode. (Refer to Right table)

An aforementioned timing chart shows display position around FULL-MODE

&lt;Horizontal&gt; (NTSC / PAL)



Note 1 : Refer to "2.7 Recommended operating condition".

Note 2 : Value in brackets correspond to PAL mode.

Note 3 :  $f_{HDN} = 15.734\text{kHz}$ ,  $f_{HDP} = 15.625\text{kHz}$ Note 4 :  $T_d = 0.208(0.210)\mu\text{s} \times n$

## 2.7 Recommended operating conditions

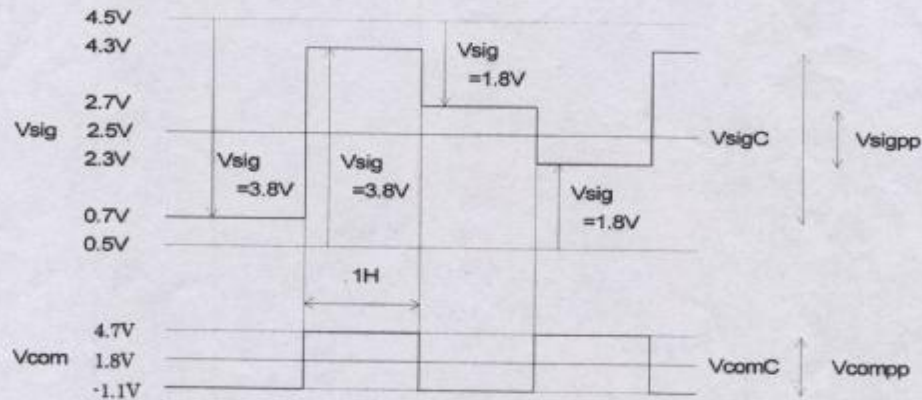
(Ta=25 ± 5°C, Vss=0V)

ITEMS	SYMBOL	CONDITONS	SPECIFICATIONS (Note 1)			UNIT	Remarks
			MIN.	TYP.	MAX.		
SUPPLY POWER VOLTAGE	V <sub>DD1</sub>	-	+3.00	+3.30	+3.60	V	
	V <sub>DD2</sub>		+4.50	+5.00	+5.50		
	V <sub>GH</sub>		+17.5	+18.5	+19.5		
	V <sub>GL</sub>		-13.0	-12.0	-11.0		
INPUT VIDEO VOLTAGE	V <sub>sigC</sub>	-	+2.4	+2.5	+2.6	V	Note 3
	V <sub>sigpp</sub>	V <sub>sigC</sub> =2.5V	3.7	4.0	4.3	V(p-p)	
COMMON SIGNAL AMPLITUDE	V <sub>comC</sub>	-	-	(+1.8)	-	V	
	V <sub>compp</sub>	-	+5.5	5.8	7.0	V(p-p)	
INPUT SIGNAL (C-MOS)	V <sub>IH</sub>	H LEVEL	0.8V <sub>DD1</sub>	-	V <sub>DD1</sub>	V	
	V <sub>IL</sub>	L LEVEL	V <sub>ss</sub>	-	0.2V <sub>DD1</sub>		
Frame frequency	f <sub>CLK</sub>	CPH	9.20	9.59 (9.53)	9.95	MHz	Note 2
		CPV	15.00	15.734 (15.625)	16.50	KHz	
	f <sub>ST</sub>	STH	15.00	15.734 (15.625)	16.50	KHz	
		STV	57.143	59.939 (50)	62.852	Hz	

Note 1: The recommended operating conditions show the ranges in which the device can operate normally.  
Operation beyond the limit of the recommended operating conditions is not assured, even though operating conditions are within the limit of the absolute maximum ratings.

Note 2 : Value in brackets correspond to PAL mode.

Note 3: Input signal timing. (V<sub>sig</sub>, V<sub>com</sub>)



Optimization of input Voltage on viewing angle is necessary.  
Adjust for minimum flicker.



## 2.8 Electrical characteristics

## 2.8.1 Electrical characteristics

Common test conditions :  $T_a = 25 \pm 5^\circ\text{C}$ ,  $\text{RH} = 65 \pm 5\%$ , $V_{DD1} = +3.3\text{V}$ ,  $V_{DD2} = +5.0\text{V}$ ,  $V_{GH} = 18.5\text{V}$ ,  $V_{GL} = -12.0\text{V}$ ,  $V_{SS} = 0\text{V}$ , $V_{\text{sigc}} = +2.5\text{V}$ ,  $V_{\text{compp}} = +5.8\text{V(p-p)}$ ,  $V_{\text{comc}} = \text{Adjust for minimum flicker}$ .

Measured after 30 minutes operation.

Items	Symbol	Conditions	Specification (Note1)			Unit	Remarks
			Min.	Typ.	Max.		
Input capacity	$C_{IN}$	-			50	pF	Note 1
	$C_{VI}$	-	-	-	200	pF	Note 2
	$C_{com}$	$f = f_{HD} / 2$	-	-	300	nF	Vcom
Supply current	$I_{DD1}$	-	1.5	2.4	2.9	mA	Note 3
	$I_{DD2}$	-	8.0	22.0	37.0	mA	
	$I_{GH}$	$V_{\text{sigpp}} = 4.0\text{V(p-p)}$	27.0	65.0	95.0	$\mu\text{A}$	
	$I_{GL}$	-	180	350	450	$\mu\text{A}$	
Input timing	$t_{CPV}$		-	-	100	kHz	
	$t_{CPVH}$		500	-	-	ns	
	$t_{CPVL}$		500	-	-	ns	
	$t_{CPH}$		-	-	20	kHz	
	$t_{CPHH}$		15	-	-	ns	
	$t_{CPHL}$		15	-	-	ns	
	$t_{SUP}$		7	-	-	ns	
	$t_{HLD}$		7	-	-	ns	
	$t_{CXSUP}$		1.0	-	-	$\mu\text{s}$	
	$t_{CXHLD}$		50	-	-	ns	

Note 1 : STV1, STV2, CPV, OE1, OE2, OE3, CPH, STH1, STH2, CX

Note 2 : VR, VG, VB

Note 3 : Timing controller current is not include.

## 2.9 Optical specifications

## 2.9.1 Optical characteristics

Common test conditions :  $T_a=25 \pm 5^\circ\text{C}$ ,  $\text{RH}=65 \pm 5\%$ , $V_{DD1}=+3.3\text{V}$ ,  $V_{DD2}=+5.0\text{V}$ ,  $V_{GH}=18.5\text{V}$ ,  $V_{GL}=-12.0\text{V}$ ,  $V_{SS}=0\text{V}$ , $V_{sigc}=+2.5\text{V}$ ,  $V_{compp}=+5.8\text{V(p-p)}$ ,  $V_{comc}$  = Adjust for minimum flicker.

Measured after 30 minutes operation.

ITEM	SYMBOL	CONDITIONS	SPECIFICATIONS			UNIT	REMARKS
			MIN.	TYP.	MAX.		
RESPONSE TIME	$t_{ON}$	$V_{sig}=4 \rightarrow 0\text{V}$	-	40	100	ms	
	$T_{OFF}$	$V_{sig}=0 \rightarrow 4\text{V}$	-	20	50		
CONTRAST RATIO	CR	$V_{sig}=0/4$	50	200	-	-	Note1,2
VIEWING ANGLE	L/R	$\theta_{10}$	45/45	55/55	-	°	
	U/D	$\phi_{10}$	15/45	30/60	-		
LUMINANCE	L	$V_{sig}=1\text{V}$	260	320	350	cd/m <sup>2</sup>	Note 2,3
AVERAGE BRIGHTNESS	L	$V_{sig}=0\text{V}$	78	-	-	cd/m <sup>2</sup>	Note 3,4
V-L THRESHOLD	$V_{th}$	90% LT	-	1.0	1.5	V	
WHITE CHROMATICITY	x	$V_{sig}=0\text{V}$	-	(0.31)	-	-	Reference Note 3
	y		-	(0.33)	-		
UNIFORMITY	DLUM	$V_{sig}=0\text{V}$	70	-	-	%	
SPECULAR REFLECTANCE RATIO	$\rho_{SP}$	non-operating	-	1	3	%	

Note 1 : 100% brightness.

Note 2 : These values vary with brightness input.

Note 3 : This spec is spectroradiometer [BM-7A].

Note 4 : Refer to "4 Measuring Method" method A

## 2.10 Display quality

### 2.10.1 Display quality (Room temperature)

Common test conditions :  $T_a=25 \pm 5^\circ\text{C}$ ,  $\text{RH}=65 \pm 5\%$ ,

$V_{DD1}=+3.3\text{V}$ ,  $V_{DD2}=+5.0\text{V}$ ,  $V_{GH}=18.5\text{V}$ ,  $V_{GL}=-12.0\text{V}$ ,  $V_{SS}=0\text{V}$ ,

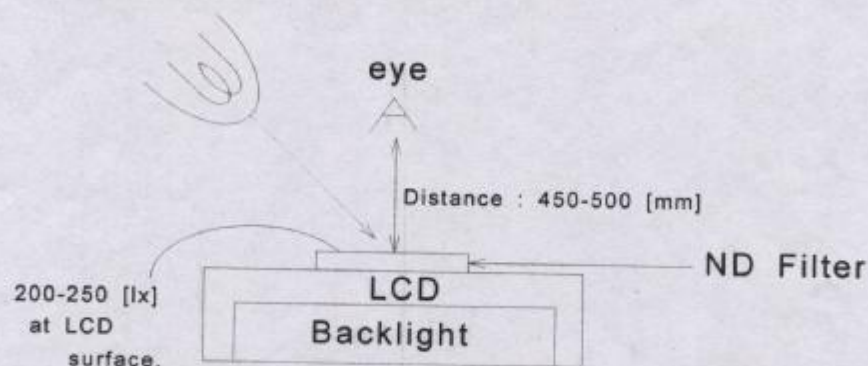
$V_{sigc}=+2.5\text{V}$ ,  $V_{comp}=+5.8\text{V(p-p)}$ ,  $V_{comc}$  = Adjust for minimum flicker.

Measured after 30 minutes operation.

Items		Definition	Standards
Display defect	Line	Black, white, color line. Horizontal or vertical line missing.	No defect
	Sub-pixel	1) Bright sub-pixel Bright defect (Black background : $V_{sig}=4.0\text{V}$ ) 2) Dark sub-pixel Dark defect (White Background : $V_{sig}=0\text{V}$ )	Note 1
Screen quality	Smear	Spot defect whose luminance isn't uniform.	Note 2 (next sheet)
	Unevenness	Partial luminance or chromatic non-uniformity.	
	Non-uniformity streak	Streak shaped luminance or chromatic non-uniformity.	
	Reverse	Concentrated unevenness (sub-pixel unit).	

Note 1 : Sub-pixel defect specifications

Inspection condition of sub-pixel defects



Bright sub-pixels are classified into the following three category using appropriate Neutral Density (ND) Filter.

Bright sub-pixel (which are) not visible through 2.5% ND Filter are not counted as bright sub-pixel.



(1) Sub-pixel defect

Items	Maximum count	Specifications		
Bright sub-pixel	-	0.3% ND	1.0% ND	2.5% ND
Level 1	2	Visible	Visible	Visible
Level 1,2	3	Invisible	Visible	Visible
Level 1 to 3	5	Invisible	Invisible	Visible
Dark sub-pixel	10	Dark defect (Vsig=0V)		
Total	10	[Bright defect(Level 1+2+3) +Dark defect]		

(2) Cluster : (Bright sub-pixel density)

The maximum permissible sub-pixel defects number per specified area one as follows.

Bright sub-pixel (Level 2 + Level 2)	2 defects in $\phi 10\text{mm}$ area
Bright sub-pixel (Level 2 + Level 3)	2 defects in $\phi 10\text{mm}$ area
Bright sub-pixel (Level 3 + Level 3)	2 defects in $\phi 10\text{mm}$ area
Dark sub-pixel	2 defects in $\phi 10\text{mm}$ area
Total (Bright and dark defects)	2 defects in $\phi 10\text{mm}$ area

(3) Linked sub-pixel defects

A) Three linked sub-pixel defects are not permissible.

B) Two linked sub-pixel defects ;

Bright + Bright : Regarded as one bright defect and classified into Level 1, 2 or 3.

Dark + Dark : Regarded as two dark defects.

Dark + Bright : Regarded as one dark defect and one bright defect (classified into Level).

(4) If any sub-pixel is counted as bright sub-pixel and dark sub-pixel, the sub-pixel is regarded as bright sub-pixel.

(5) Dusts (in Cell)

	Size	Judgement
1	3 sub-pixels $\leq x$	NG
2	2 sub-pixels $\leq x < 3$ sub-pixels	Regarded as two linked dark defects.
3	1 sub-pixel $\leq x < 2$ sub-pixels	Regarded as one dark defect.
4	$\leq x < 1$ sub-pixel	Uncounted.

Note 2 : Screen quality defects (smear etc.), which can not be found by using 2.5% ND filter, shall not be counted as defects.

Inspection condition : Same as sub-pixel defect condition.

## 2.11 Reliability test

## 2.11.1 Environmental &amp; life test

Items	Conditions	Judgement time
High temperature operation	$T_a = 65 \pm 2^\circ\text{C}$ , $\text{RH} \leq 45\%$	192h
High temperature and high humidity operation	$T_a = 65 \pm 2^\circ\text{C}$ , $\text{RH} = 90 \pm 2\%$	192h
Low temperature operation	$T_a = -30 \pm 3^\circ\text{C}$	192h
High temperature storage	$T_a = 85 \pm 2^\circ\text{C}$ , $\text{RH} \leq 45\%$	192h
Low temperature storage	$T_a = -40 \pm 3^\circ\text{C}$	192h
Light stability non-operating	Sun shine carbon arc, $T_a = 63 \pm 2^\circ\text{C}$	360h
Thermal shock non-operating	$-30^\circ\text{C}$ (60min.) $\longleftrightarrow$ $25^\circ\text{C}$ (15min.) $\longleftrightarrow$ $80^\circ\text{C}$ (60min.)	20 cycle
Condensation test	$-30^\circ\text{C}$ (30min. non-operation) $\longleftrightarrow$ $25^\circ\text{C}/95\%$ (10min. operation)	10 cycle
Temperature and humidity cycling non-operating	<p>1 cycle = 48h (25 to <math>65^\circ\text{C}</math> : 90 to 95%)</p>	5 cycle
Static discharge durability	$C=200\text{pF}$ , $R=0\Omega$ , $V=\pm 150\text{V}$ Electric discharge between power supply terminals and other terminals [non-operating]	each terminals 3 times
Surface electric Discharge durability	$C=150\text{pF}$ , $R=150\Omega$ , $V=\pm 15\text{kV}$ Electric discharge between LCD panel and ground. (positive and negative) [non-operating]	positive and negative 5 times each
Front force test	Push-pull head : $\phi 12.7\text{mm}$ , $5 \times 9.8\text{N}$ [non-operating]	a time
Atmospheric pressure stability	$5.06 \times 10^4 \text{ Pa}$ [non-operating]	2h



## 2.11.2 Reliability test criteria

Items	Specification (Note 1)				Remark
	Contrast	Luminance	Supply current	Screen quality	
High temperature operation	$30 \leq CR$	$\leq \pm 20\%$	$\leq + 40\%$	Note 2	Note 3
High temperature and high humidity operation	$25 \leq CR$	"	"	"	Note 3,4
Low temperature operation	$30 \leq CR$	"	"	"	Note 3
High temperature storage	"	"	"	"	Note 3
Low temperature storage	"	"	"	"	Note 3
Light stability non-operating	"	"	"	"	Note 3
Thermal shock non-operating	"	"	"	"	Note 3
Condensation test	$25 \leq CR$	"	"	"	Note 5
Temperature and humidity cycling non-operating	"	"	"	"	Note 5
Static discharge durability non-operating	No abnormal function or indication				
Surface electric discharge durability non-operating	"				
Front force test	"				
Atmospheric pressure stability non-operating	"				

Note 1 : The Change quantity for initial value.

Note 2 : Screen quality should not have distinguished unevenness.

Note 3 : Measured after 2 hours storage in room temperature.

Note 4 : Degradation due to the degradation of polarizer is excluded.

Note 5 : Measured after 24 hours storage in room temperature.



## 3. Measuring Method

## 3.1 Mechanical &amp; electrical items

Inspection or test items	Measuring systems or definition
1. Mechanical	
A) Critical dimensions	Vernier caliper
B) Marking	Visual
C) Appearance	Visual
2. Electrical	
1) Supply current	Ampere meter
2) Input capacitance	Capacitance meter

## 3.2 Optical items

## 3.2.1 Standard measuring conditions

Measure on the following conditions.

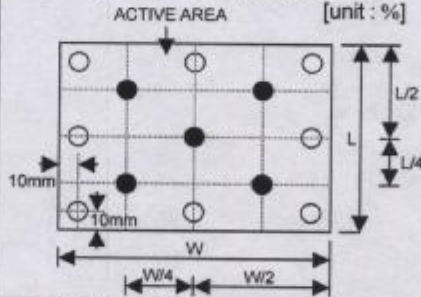
Operating voltage :  $V_{DD1}=+3.3V$ ,  $V_{DD2}=+5.0V$ ,  $V_{GH}=+18.5V$ ,  $V_{GL}=-12.0V$ ,  $V_{SS}=0V$ ,  
 $V_{sigc}=+2.5V$ ,  $V_{comp}=5.8V$ ,  $V_{comc}$ =Adjust for minimum flicker.  
 ( Measured after 30 minutes operation)

Measurement Back-light : Standart back-light (Luminance : 5000 cd/m<sup>2</sup>)

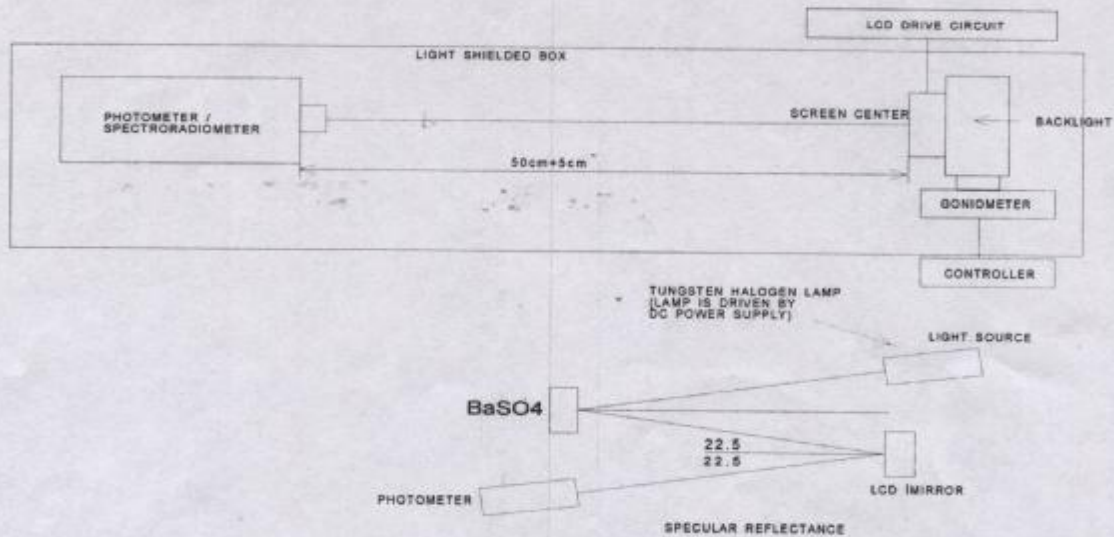
Measurement temperature :  $T_a=25 \pm 2^\circ C$

The Measurement point : Measuring one point of the screen center.

Set the luminance meter above the normal line of the LCD module.

Inspection or test items	Measuring systems or definition	System
1. Contrast ratio	$CR = L1 / L2$ $L1 : V_{sig}=0V$ , $L2 : V_{sig}=4V$	method A (Next sheet)
2. Luminance (L)	Raster pattern ( $V_{sig} = 0V$ )	method A
3. Viewing angle left / right ( $\theta$ ) up / down ( $\phi$ )	CR is larger than 10	method A
4. V-L threshold ( $V_{th}$ )	$L = V_{sig} 0 \text{ to } 4V$ ( step : 0.2V ) $V_{th} = L (90\%)$	method A
5. Uniformity	$L = V_{sig}(0V)$ $Uniformity = L (\text{min.}) / L (\text{max.}) \times 100$ [unit : %] 	method A
6. Specular reflectance	$\rho_{SP} = L3 / L4$ $L3$ : Non-operating LCD luminance $L4$ : Mirror luminance	method A
7. Display defect and screen quality	Inspection shall be performed right above the module, apart 500mm from the module to eyes. ( $V_{sig}=0$ to 4V)	Visual inspection

### 3.2.2 Measuring systems Method A (distant method)



LCD drive circuit : Supplies raster pattern to LCD.

Photometer : BM-7 A(made in TOPCON).

Spectroradiometer : BM-7A (made in TOPCON).